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Scientific, Technical and Economic Committee for Fisheries (STECF)

Assessment of Mediterranean Sea stocks - part 1 (STECF-11-08)

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This report was reviewed by the STECF during its 37th plenary meeting held from 11 to 15 July, 2011 in Copenhagen, Denmark

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

Assessment of Mediterranean Sea stocks - part 1 (STECF EWG 11-05)

THIS REPORT WAS ADOPTED DURING THE PLENARY MEETING HELD IN COPENHAGEN 11-15 July 2011

Request to the STECF

STECF is requested to review the report of the **EWG-11-05** held from 23 – 27 May 2011 on Ponza Island, Italy, to evaluate the findings and make any appropriate comments and recommendations.

STECF observation

The report of EWG 11-05 is available here https://stecf.jrc.ec.europa.eu/reports/medbs. The EWG-11-05 has provided quantitative stock assessments for several Mediterranean stocks not previously assessed, and updated assessments for several stocks using the most recent data available. STECF notes that with the exception of two items (ToR L -influence of sea-bottom temperature on trawl swept-area estimations and ToR H – 'R'-scripts to evaluate MEDITS and other CPUE data series), all other ToRs were successfully addressed. EWG-11-05 was unable to respond to items L and H due to the non-availability of the experts that had been invited to attend the WG.

STECF notes that the assessments and management advice provided in the present report are limited to the Geographical Sub-areas (GSA) off Spain, Italy and Malta since no experts from Cyprus, France, Greece and Slovenia were able to attend the meeting. The assessments were constrained by the availability of fisheries data up to and including 2009 and survey data up to and including 2010. Data updates including years 2010 and 2011 were not available to the experts as the meeting was held quite early in 2011 before the 2011 DCF data was published.

STECF notes that the EWG 11-05 found the participation of the two observers from France (IFREMER and French Administration) extremely helpful in dealing with the evaluation of the French management plans.

STECF conclusions

STECF draws the following conclusions from the EWG-11-05 report.

Stock assessments: ToRs (A-E)

Assessment of Mediterranean exploited stocks and fisheries, were addressed by revising assessments undertaken by the expert group in 2010 and assessing the status of stocks which had not been previously assessed. A total of twelve assessments were carried out and for nine stocks. Their exploitation status was analytically assessed and evaluated against the proposed F_{MSY} reference point. If appropriate data are available, additional stock and fisheries assessments will be carried out during the next two EWG meetings scheduled for 26-30 September 2011 and 16-20 January 2012. Short and medium term predictions of stock biomass and catches will also be attempted.

Results of assessments carried out for European hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), and blue and red shrimp (*Aristeus antennatus*) in GSA 01, and for blue and red shrimp *Aristeus antennatus*, spottail mantis shrimp *Squilla mantis*, striped red mullet *Mullus surmuletus*, and blackmouth catshark *Galeus melastomus*) in GSA 09 indicate that in 2009, fishing mortality (F) on all of these stocks was above F_{msy}.. The status of the pink shrimp (*Parapaeneus longirostris*) stock in GSA 11 could not be assessed due to data limitations. A revised assessment for common sole (*Solea solea*) in GSA17 based on survey data only, also indicated that overfishing is occurring on this stock ($F \geq F_{msy}$). STECF considers that this finding is provisional and the stock status will be reassessed during one of the forthcoming EWGs scheduled for late 2011 and early 2012, assuming that appropriate fishery dependent data are made available.

A summary of the stock assessment results from the STECF-EWG 11-05 report is given in Table below.

Summary of assessment results by stock, method used, reference points and current exploitation status (Diagnosis).

Species	GSA	Assesment	Period	Method	Management Reference points	Diagnosis
European hake (*Merluccius merluccius*)	1	Updated	(2008-2009)	Length Cohort Analysis (VIT software); Y/R	$F_{0.1} \leq 0.21$ as limit reference point (F_{MSY} proxy)	overfishing
Red mullet (*Mullus barbatus*)	1	Updated	(2008-2009)	Length Cohort Analysis (VIT software); Y/R	$F_{0.1}$=0.52 as limit reference point (F_{msy} proxy)	overfishing
Red shrimp (*Aristeus antennatus*)	1	New	(2005-2009)	Length Cohort Analysis (VIT software); Y/R	$F_{0.1} \leq 0.29$ limit reference point (F_{MSY} proxy)	overfishing
Red shrimp (*Aristeus antennatus*)	9	New	(2006-2009)	Length Cohort Analysis (VIT software); Y/R	$F_{0.1} \leq 0.32$ limit reference point (F_{MSY} proxy)	overfishing
Spottail mantis shrimp (*Squilla mantis*)	9	New	2009	Length Cohort Analysis (VIT software); Y/R	$F_{0.1} \leq 0.64$ as limit reference point (F_{MSY} proxy)	overfishing
Striped red mullet (*Mullus surmuletus*)	9	New	2010	Length Cohort Analysis (VIT software); Y/R	$F_{0.1} \leq 0.31$ as limit reference point (F_{MSY} proxy)	overfishing
Blackmouth catshark (*Galeus melastomus*)	9	New	2009	Length Cohort Analysis (VIT software); Y/R	$F_{0.1} \leq 0.12$ as limit reference point (F_{MSY} proxy	overfishing
Pink shrimp (*Parapaeneus longirostris*)	11	New	(1994-2009)	SURBA (1994-2009); VIT (2009); Y/R	$F_{0.1} \leq 0.82$ as limit reference point (F_{MSY} proxy)	Not conclusive
Common sole (*Solea solea*)	17	Updated	(2005-2010)	Catch curve analyses (Z trends); SURBA ; VIT; Y/R	$F_{0.1} \leq 0.26$ as limit management reference point (F_{MSY} proxy)	overfishing

Quality of data from 2010 DCF data call ToR F

STECF concludes that the various comments and remarks on data quality and data inconsistencies provided in the report of the EWG 11-05 should be communicated to DG Mare and MSs for consideration.

STECF notes that EWG 11-05 tested empirical biological indicators and methodologies for stock assessments lacking standard data requirements (**ToR G**). STECF concludes that the SEINE method (Gedamke & Hoenig, 2006) is an appropriate method to estimate total mortality rates (Z) when only length composition data are available, provided that the input data are representative of the full size range of the population. STECF concludes that the method can provide robust estimates of Z in cases where both adults and juveniles from a stock are effectively sampled. In cases where juveniles or adults are not representatively sampled by the gear, which tends to be the case for species attaining a larger size, the method is less reliable.

STECF agrees that the demersal fisheries in the Mediterranean are primarily mixed-species fisheries. STECF also shares the opinion of the EWG 11-05 that fishery-specific effort ceilings in mixed demersal fisheries in the Mediterranean could substantially contribute to achieve and maintain sustainable exploitation rates. This is consistent with previous advice from STECF and is in accordance with the GFCM resolution GFCM/33/2009/1. However, STECF notes that in some circumstances, management of demersal mixed fisheries to achieve sustainable exploitation rates in line with MSY objectives through effort regulation alone may be inadequate. For example, for species that exhibit aggregating behaviour, effort limitations may be insufficient to control the exploitation rate if the fisheries are able to locate the aggregations. In such cases, alternative or complimentary measures such as technical measures to make the fishing gear more species- or size- selective may be required. STECF concludes that the management of demersal mixed fisheries in the Mediterranean to achieve simultaneous objectives is a complex issue and in order to continue to provide informed advice, the EWGs dealing with Mediterranean fisheries should continue to assess the likely outcomes of alternative management strategies.

STECF notes that EWG 11-05 also reviewed a National management plan submitted by the French Authorities for the fishing fleets operating in the French Mediterranean (**ToR L**). STECF concludes that while the French submission provides a detailed description of the different métier, the information on the conservation status and the biological characteristics of the stocks is rather limited, and the impacts of small-scale fishing gears operating in coastal waters on habitats and species remain largely unaddressed. Furthermore, measures for the protection of coastal habitats essential as nursery or spawning areas for many fish species (such as *Posidonia oceanica* beds and coralliferous assemblages) has not been sufficiently addressed in the plan. Other important shortfalls in the French submission are a lack of a clear definition of the objectives, and the justification of the time schedules proposed for the different proposals in the management plans. Given the lack of appropriate information to assess the potential impact of any future proposed measures, STECF considers that such information be collected and compiled and be submitted in support of future management plans.

STECF recommendations

The results of the EWG 11-05 assessments indicate that in order to meet MSY objectives the fishing mortality of European hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), and blue and red shrimp (*Aristeus antennatus*) in GSA 01, blue and red shrimp (*Aristeus antennatus*), spottail mantis shrimp (*Squilla mantis*), striped red mullet (*Mullus surmuletus*), and blackmouth catshark (*Galeus* *melastomus*) in GSA 09, pink shrimp the (*Parapaeneus longirostris*) in GSA 11 and common sole (*Solea solea*) in GSA 17 and needs to be reduced. Recalling GFCM resolution GFCM/33/2009/1, STECF recommends that this would best be achieved by means of a multi-annual management plan taking into account mixed-fisheries effects.

Quality and completeness of the official 2010 Mediterranean DCF data call

STECF recommends that the detailed comments by EWG 11-05 concerning quality and completeness of the national data submissions to the 2010 Mediterranean DCF data call should be noted by DG Mare and communicated to the national correspondents of the Member States' DCF program.

Considering the sparseness of fisheries and fisheries independent (survey) data to monitor and assess the status of exploited stocks in the coastal regions of the Mediterranean Sea, STECF recommends that a special sampling plan to survey coastal artisanal, recreational and commercial fisheries should be drawn up and implemented. An expert working group which includes participants with specialist knowledge of Mediterranean coastal fisheries and surveys should develop an appropriate sampling protocol. In addition, the expert group should advise on a selection of appropriate indicator species for the assessment of environmental status and propose any amendments required for a future revision of the DCF revision related to monitoring and assessment of the status of coastal exploited species and ecosystems.

Expert Working Group report

REPORT TO THE STECF

EXPERT WORKING GROUP ON Assessment of Mediterranean Sea stocks - part 1 (STECF EWG 11-05)

Ponza Island, 23-27 May 2011

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

1 EXECUTIVE SUMMARY

The EWG 11-05 met in Ponza Island (Italy), 23-27 May 2011 to carry on STECF's mandate for assessing Mediterranean stocks and provide fisheries management. The meeting was chaired by A. Abella and attended by seventeen experts, including four STECF members and two JRC experts. In addition, a representative of the DG Mare attended the meeting as well as two French observers attending it on a part time basis. The presence of the observers was considered constructive and very helpful to increase the effectiveness to deal with specific tasks regarding the evaluation of the French management plans.

The major ToRs (A-E), the assessment of Mediterranean exploited stocks and fisheries, were addressed by revising assessment results provided by the expert group in 2010 and defining the status of stocks which have not been assessed before. The assessments of recent and historic stock parameters and fisheries as well as management advice provided in the present report is constrained for the Geographical Sub-areas (GSA) off Spain, Italy and Malta since no experts from Cyprus, France, Greece and Slovenia attended the meeting. The twelve assessments of exploited stocks and fisheries resulted in nine cases where the stocks' exploitation status could be analytically assessed and evaluated against the proposed F_{MSY} limit reference point. The assessments were constrained by the availability of fisheries data up to and including 2009 and survey data up to and including 2010. Data updates including years 2010 and 2011 were not available to the experts as the meeting was hold quite early in the year 2011 and the 2011 DCF data call for the Mediterranean was still under construction and not published by DG Mare.

The EWG 11-05 devoted some time to verify the data obtained during the DCF Mediterranean data call in 2010 (ToR F) for completeness and accuracy. The present report contains findings for further consideration by STECF and DG Mare regarding GSAs off Spain, Italy and Malta as well as comments regarding small pelagic and spatial coverage of costal species.

ToRs G covered the task of the development of appropriate biological indicators, and methods for stock assessments in poor data situation were addressed using the SEINE method for a number of Mediterranean stocks.

ToRs H on the development of the R software to facilitate specific evaluations could not be addressed due to lack of expertise. Depending on the presence of the specific expertise, this task will be continued during future expert meetings.

The EWG 11-05 started to discuss and evaluate the mixed fisheries frameworks and computer programs to deliver mixed fisheries management advice under various scenarios (ToR I). As many of the Mediterranean fisheries are classified as mixed fisheries, this specific issue is considered very important and relevant analyses shall be continued during the forth-coming meetings.

Logistic issues regarding future Mediterranean fisheries expert meetings within the STECF frameworks were noticed and commented under ToR K.

No specific analysis regarding the requested evaluation of the influence of sea-bottom temperature on trawl swept-area estimations could be undertaken due to lack of appropriate scientific expertise and limted working time. Under the same ToR L covering all other business, the EWG 11-05 initiated its evaluation of the French management plan as presented at short notice.

More detailed responses regarding specific conclusions and recommendations are provided in the following two secions of the present report.

2 CONCLUSIONS OF THE WORKING GROUP

ToR A-E update and assess historic and recent stock parameters: The EWG 11-05 undertook twelve detailed approaches to assess the status of exploited demersal Mediterranean resources and their fisheries. In nine cases, the EWG 11-05 provided detailed summary sheets informing about the stocks' status and their status of exploitation in relation to proposed management reference points consistent with high long term yields (F_{MSY}). While the stock size status could not be evaluated, the STECF EWG 11-05 concludes that the

- three assessed stocks in GSA 01 of European hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), and blue and red shrimp (*Aristeus antennatus*) are subject to overfishing.

- four assessed stocks in GSA 09 of blue and red shrimp (*Aristeus antennatus*), spottail mantis shrimp (*Squilla mantis*), striped red mullet (*Mullus surmuletus*), and blackmouth catshark (*Galeus melastomus*) are subject to overfishing.

- stock of pink shrimp (*Parapaeneus longirostris*) in GSA 11 cannot be evaluated due to data constraints

- stock of common sole (*Solea solea*) in GSA 17 is subject to overfishing, conditional of the assumption that the survey based selection patterns, as well as the temporal and spatial effort distributions are not significantly different from the commercial fisheries.

EWG 11-05 further concludes that short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending on data availability.

ToR F Quality and completeness of the official Mediterranean DCF data call: The EWG 11-05 scrutinized the data obtained from the 2010 DCF Mediterranean data call for consistency and completeness only in Spanish and Maltese GSAs. Detailed comments are provided in the present report, with particular emphasis on coastal species. EWG was unable to review data from other MS due to the lack of sufficient expertise among the participants to the meeting and time constraints.

ToR G Empirical biologic indicators and methodologies for stock assessments lacking standard data requirements: EWG 11-05 tested the so-called SEINE method derived by Gedamke & Hoenig (2006) using a mean length approach which does not require equilibrium conditions by estimating total mortality (Z) for several species historically not assessed in GSA 09. EWG 11-05 concludes that the SEINE method is a rather simple, less data demanding method that in theory could be used to derive estimates of Z for any species for which representative length data of the population from survey or from commercial catches are available. Having a minimal data requirement, it has also the potential for a widespread use in data poor situation as it is the case for several species exploited in the Mediterranean Sea. However, it is also clear that its use is not suitable for those species that are not representatively sampled (i.e. those that show different vulnerability-accessibility by size). In general, EWG 11-05 concludes that for small sized species where both adults and juveniles are effectively sampled by the gear, the SEINE method has the potential to provide a robust estimate of Z and detect eventual temporal changes in total mortality rates. On the other hand, the method is less suitable for large sized species or for species where juvenile or adults are not caught by the gear used.

ToR H Computer program R-scripts to evaluate MEDITS and other CPUE data series: EWG 11-05 was unable to address the task to further elaborate and test the developed R scripts to facilitate the evaluation of both survey and commercial data series due to lack of expertise and time during the meeting.

ToR I Frameworks to deliver management advice for multi-species/stocks fisheries: EWG 11-05 discussed four different approaches to analyse and provide management advice regarding mixed fisheries. EWG 11-05 noted that the great majority of Mediterranean stocks are exploited by multi-species (mixed) fisheries, particularly the near bottom and bottom dwelling species due to their coexistence in diverse communities and the poor selectivity of many gears used. Still, the variety of exploited stocks in mixed fisheries requires specific conservation needs as defined by the Marine Strategy Framework Directive (EU 2008, EU COM 2011) based on the specific ecological role and stock status (Piet *et al*., 2010). It is further noted, that the selection of the various mixed fisheries involved in the exploitation of certain stocks potentially varies with the areas, gears and the fishing strategies. It is argued that the mixed fisheries are best managed by fishing effort, if they deploy trawled (active) gears. This can be done by settings of maximum allowable effort (TAE) in units of days at sea or the product of kilo Watt times days at sea to account for boat specific fishing power. The applicability of such effort measures or alternative ones regarding passive demersal gears has still to be proven. Fishing grounds with high stratification, e.g. along narrow continental shelves, may force certain stocks or parts of them to occur highly aggregated and thus make pure effort measures ineffective to control fishing mortality, like in the example of pelagic fisheries or particular demersal species with an aggregation behaviour during part of the life cycle. However, catch figures estimated and set consistently with effort constraints (TAE) will help to communicate foreseen constraints in fishing possibilities to the involved stakeholders.

ToR K Future planning of Mediterranean expert group meetings: No specific conclusions were made by STECF EWG 11-05.

ToR L Other Business - Influence of sea-bottom temperature on trawl swept-area estimations: The expert working group did not address this task due to lack of appropriate scientific expertise and working time.

ToR L Other Business - Assessment of management plan(s) submitted by France for the fishing fleets operating in the Mediterranean: STECF EWG 11-05 concludes that the complexity of the different type of fisheries in the area is particularly well described in the French Management Plans (FMP). Within each fishing gear, there are different modalities targeting different species in different habitats or depths. Nevertheless, the information on the conservation status and the biological characteristics of the stocks is rather limited, and the impact of small-scale fishing gears operating in coastal waters included in the management plan on habitats and species remains largely unknown and thus appears inadequately considered with regards to the precautionary principle. STECF EWG 11-05 concludes that the protection of the important coastal habitats, particularly the protected ones such as *Posidonia oceanic*a beds and coralligenous assemblages essential for the population dynamics of coastal species (nursery or spawning areas), appears poorly addressed.

STECF EWG 11-05 concludes that despite the large amount of information related to different aspects of the fishing activity, basic information which must be part of a management plan is missing. Major shortfalls identified in the French Management Plan (FMP) are the lack of knowledge of the status of most of the exploited stocks, a clear definition of the objectives, and the justification of the time schedule proposed for the different management plans. The FMP indicates 01.01.2011 as starting date and a two years period for the preliminary phase of the plan. The objectives during this phase are defined as qualitative only.The French government announced a revision of the plan by the first semester in 2013, which shall include the required quantitative management objectives. The FMP proposes to start the collection of specific fisheries information by métier, which to date is not available. To this aim, the plan identifies different traditional métiers, for which derogations are required to continue their activities, although it remains unclear to STECF EWG 11-05 whether such derogations have already been granted.

3 RECOMMENDATIONS OF THE WORKING GROUP

ToR A-E update and assess historic and recent stock parameters: The EWG 11-05 recommends that the effort of the relevant fleets' catching European hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), and blue and red shrimp (*Aristeus antennatus*) in GSA 01, blue and red shrimp (*Aristeus antennatus*), spottail mantis shrimp (*Squilla mantis*), striped red mullet (*Mullus surmuletus*), and blackmouth catshark (*Galeus melastomus*) in GSA 09, pink shrimp (*Parapaeneus longirostris*) in GSA 11 and common sole (*Solea solea*) in GSA 17, be reduced until fishing mortality is below or at the proposed reference level F_{MSY}, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plan taking into account mixed-fisheries effects. Catches and effort consistent with F_{MSY} should be estimated. For common sole EWG 11-05 recommends that a specific multi-annual management plan be developed considering multi-species effects and a set of specific rules for the rapido trawl fishery (e.g.: size and number of gears, mesh size, towing speed, spatial and/or temporal closure). A two–months closure for rapido trawling inside 11 km off-shore along the Italian coast in GSA 17, after the biological fishing ban (August), may be considered to reduce the portion of juvenile specimens in the catches (sensitive period).

ToR F Quality and completeness of the official Mediterranean DCF data call: The EWG 11-05 recommends that its detailed comments provided in the present report shall be noted by STECF and be forwarded to DG Mare. With particular emphasis on the coastal species EWG 11-05 recommends that

- a specific sampling plan to survey coastal species should be implemented which considers both artisanal as well as recreational fisheries. For that, it would be necessary to establish an EU working group specialised in coastal fisheries to design a specific sampling protocol in coastal waters. This plan should consider both commercial and recreational fishing sectors and the possible implementation of a specific fishery independent scientific survey (e.g. trammel net survey and visual census) in particular areas along the coast.

- the future revision of the DCF data call considers the collection of data of some few coastal species that are good indicators of the status of particular coastal areas. These should include species that are vulnerable to both fishing and other impacts (habitat destruction or modification, climate change, etc) because of their life history traits (slow growth, complex reproductive strategy, etc.).

ToR G Empirical biologic indicators and methodologies for stock assessments lacking standard data requirements: No particular recommendations were made by STECF EWG 11-05.

ToR H Computer program R-scripts to evaluate MEDITS and other CPUE data series: In the absence of appropriate expertise EWG 11-05 was unable to address the task to further develop and test the developed R scripts to facilitate the evaluation of both survey and commercial data series, and EWG 11-05 recommends to defer the task to future meetings.

ToR I Frameworks to deliver management advice for multi-species/stocks fisheries: STECF EWG 11-05 recommends that the design of a multi-annual management plan for demersal fisheries in GSA 9, in addition to a significant reduction in the effort of relvant fisheries, shall consider the option of a disproportional and fisheries specific approach to optimize catch options consistent with conservation requirements and fishing effort deployed. STECF EWG 11-05 further recommends that the potential use of existing devices to improve the selectivity of mixed fisheries shall be evaluated and promoted in order to simplify overly complex fisheries strategies through reduction of by-catch.

ToR K Future planning of Mediterranean expert group meetings: No specific recommendations were made by STECF EWG 11-05..

ToR L Other Business - Influence of sea-bottom temperature on trawl swept-area estimations: No specific recommendations were made by STECF EWG 11-05..

ToR L Other Business - Assessment of management plan(s) submitted by France for the fishing fleets operating in the Mediterranean: No specific recommendations were made by STECF EWG 11-05..

4 INTRODUCTION

The expert working group on Mediterranean stock and fisheries assessment STECF EWG 11-05 held its first out of three meetings planned in 2011 on Ponza Island, Italy, 23-27 May 2011. The chairman opened the meeting at 9.00 am on Monday, 23 May 2011, and adjourned the meeting by 4.00 pm on Friday, 27 May 2011. The meeting was attended by 17 experts, including 4 STECF members and 2 JRC experts. Franco Biagi represented DG Mare, and 2 observers from the French ministry attended part time to address the specific ToR on the French management plans.

The structure of the present report is in accordance with the terms of reference to STECF, as defined in the following chapter.

4.1 Terms of Reference for EWG 11-05

The STECF is requested to

a) update and assess historic and recent stock parameters for the longest time series possible of the species listed below and parameters of their fisheries (by fleets) by all relevant individual GSAs in the Mediterranean Sea or combined GSAs where appropriate, with emphasis on stocks not yet assessed analytically. Assessment data and methods are to be fully documented with particular reference to the completeness and quality of the data submitted by Member States as response to the official Mediterranean DCF data call issued on 29 April 2010. To the extent possible, the assessment shall provide the target (biological, bio-economic), the precautionary (threshold) and conservation (limit) reference points, either model based or empirical. Data collected outside the DCF and/or delivered to the meeting by non-EU scientists shall be used as well and merged with DCF data whenever necessary. Due account shall also be given to data used and assessments carried out by the FAO-regional projects co-funded by the European Commission and EU-Member States.

•Sardine (*Sardina pilchardus*)
•Anchovy (*Engraulis encrasicolus*)
•European hake (*Merluccius merluccius*)
•Common sole (*Solea solea*)
•Red mullet (*Mullus barbatus*)
•Deep-water rose shrimp (*Parapenaeus longirostris*)
•Red shrimp (*Aristeus antennatus*)
•Giant red shrimp (*Aristaeomorpha foliacea*)
•Norway lobster (*Nephrops norvegicus*)

b) assess historic and recent stock parameters for the longest time series possible of the species listed below and parameters of their fisheries (by fleets) by all relevant individual GSAs in the Mediterranean Sea or combined GSAs where appropriate. Assessment data and methods are to be fully documented with particular reference to the completeness and quality of the data submitted by Member States as response to the official Mediterranean DCF data call issued on 29 April 2010. To the extent possible, the assessment shall provide the target (biological, bio-economic), the precautionary (threshold) and conservation (limit) reference points, either model based or empirical. Data collected outside the DCF and/or delivered to the meeting by non-EU scientists shall be used as well and merged with DCF data whenever necessary. Due account shall also be given to data used and assessments carried out by the FAO-regional projects co-funded by the European Commission and EU-Member States.

•Picarel (*Spicara smaris*)
•Other species of the Tables 1 and 2 of the official Mediterranean DCF data call issued on 29 April 2010 (see annex) with particular attention to: Common Pandora (*Pagellus erythrinus*), striped red mullet (*Mullus surmuletus*), bogue (*Boops boops*), sea bass (*Dicentrarchus labrax*), blue whiting (*Micromesistius poutassou*), gilthead seabream (*Sparus aurata*), Blackspot seabream (*Pagellus bogaraveo*), Poor cod (*Trisopterus minutus*), Sargo breams (*Diplodus spp.*), mackerel (*Scomber spp.*), spottail mantis squillid (*Squilla mantis*)

c) review of assessments of historic and recent stock parameters of demersal and small pelagic species listed under a) and b) and assessments of their fisheries in the Mediterranean Sea as conducted by other scientific frameworks including also national frameworks of non-EU countries. Due account shall also be given to data used and assessments carried out by the FAO-regional projects co-funded by the European Commission and EU-Member States.

d) assess, propose and review biological fisheries management reference points, either model based or empirical, of exploitation and stock size related to high yields and low risk of fishery collapse in long term of each of the stocks listed under a), b) and c) and assessed by STECF or other scientific frameworks. This work shall provide, to the extent possible, the target (biological, bio-economic), the precautionary (threshold) and conservation (limit) reference points. Assessment data and methods are to be fully documented with particular reference to the completeness and quality of the data submitted by Member States as response to the official Mediterranean DCF data call issued on 29 April.

e) advise on the recent status of exploitation and stock size of the species listed under a), b) and c) in relation to the biological fisheries management reference points as identified under d).

f) review the quality and completeness of all data resulting from the official Mediterranean DCF data call issued on 29 April 2010. STECF is requested to summarize and concisely describe in detail all data quality deficiencies of relevance for the assessment of stocks and fisheries. Such review and description are to be based on data reformatted to the revised data format of DCF data calls for the Mediterranean and Black Seas as compiled and provided by JRC in accordance with the STECF advice from the plenary held during 11-15 April 2011. The description will support further reconciliation of national DCF programs.

g) test the empirical biologic indicators and methodologies for their calculation recommended by STECF SGMED-10-01 to be applied for stock assessments lacking standard data requirements. Such tests should be run using the examples of stocks, for which the standard data requirements are fulfilled. STECF is requested to comment on the applicability of the results obtained from the empirical indicators for scientifically sound fisheries management advice.

h) continue the formulation of the program R-scripts and to test them to evaluate MEDITS and other CPUE or abundance survey results as initialized during STECF SGMED-10-01. As a first priority, the survey evaluation should allow assessments of trends in stock specific abundance and biomass trends, also length and age based, not only for the total stock but also separately for the juvenile and adult components. As a second priority, standardization between independent time series of surveys with respective parameters of correlation, bias and precision shall be realized.

It would be advisable to carry out comparisons for consistency with outputs from other d-bases as developed at national/international levels including also the the AdriaMed Trawl Surveys Information Systems (ATrIS).

i) review and evaluate existing scientific frameworks for the elaboration of mixed fisheries management advice, and develop a framework to deliver management advice for multi-species/stocks fisheries in the Mediterranean and Black Seas. Such framework shall consider and be consistent with the management advice for fisheries of single species/stocks provided by STECF so far and provide medium term scenarios constrained by one or all species/stock specific management points to be achieved by 2015 or 2020, respectively. The framework shall be age-structured, to the extent possible, and be based on ecological data and concepts as a first step; considerations shall be given to accommodate within this framework, whenever necessary, empirical indicators. The input data required and model processes to deliver management advice for multi-species/stocks fisheries shall be described in detail. The management advice shall consider quantitative annual effort changes and consistent catch possibilities. The link to and incorporation of economic data and concepts shall be further elaborated as a follow up. The use of multiple indicators, either model based or empirical and of biological and/or economic nature, within a single management advice framework shall be considered and commented as adequate.

k) note that the last STECF expert meeting in 2011 (EWG 11-20: Assessment of Mediterranean Sea stocks - part 3), previously being planned for the period 12-16 December 2011, is deferred and will now be convened from 16-20 January 2012. The expert meeting will focus on short and medium term projections of stock size and catches as well as bio-economic modeling as successfully conducted in since 2009.

l) any Other Business:

- evaluate the influence of sea-bottom temperature on trawl swept-area estimations.

- Assessment of management plan(s) submitted by France for the fishing fleets operating in the Mediterranean

STECF EWG 11-05 is requested to review the scientific basis for management plan(s) as required by the Mediterranean Regulation (C.R. (EC) No1967/2006), to evaluate its findings, to make appropriate comments, also with respect to the elements/measures included in the proposed management plan and to advise whether the plan contains elements that account for:

1. the biological characteristics and the state of the exploited resources,
2. the fishing pressure and if concerned fisheries are duly described and expected to exploit main target stocks in line with their production potentials and if the plan is expected to maintain or to revert fisheries productivity to higher levels and in which time frame.
3. impact of fishing activities on marine environment (protected habitats and species)
4. size and/or species selectivity of the regulated fishing gears with particular attention to sizes and relative quantities of species mentioned in Annex III of the Mediterranean Regulation.

Table 1: Additional species as included in the data collection regulations.

Species common name, species scientific name FAO CODE
1. Bogue *Boops boops* BOG
2. Common dolphinfish *Coryphaena hippurus* DOL
3. Sea bass *Dicentrarchus labrax* BSS
4. Grey gurnard *Eutrigla gurnardus* GUG
5. Black-bellied angler *Lophius budegassa* ANK
6. Anglerfish *Lophius piscatorius* MON
7. Blue whiting *Micromesistius poutassou* WHB
8. Grey mullets (*Mugilidae*) Mugilidae MUL
9. Common Pandora *Pagellus erythrinus* PAC
10. Caramote prawn *Penaeus kerathurus* TGS
11. Mackerel *Scomber spp.* MAZ
12. Common sole *Solea solea* (=*Solea vulgaris*) SOL
13. Gilthead seabream *Sparus aurata* SBG
14. Spottail mantis squillids *Squilla mantis* MTS
15. Mediterranean horse mackerel *Trachurus mediterraneus* HMM
16. Horse mackerel *Trachurus trachurus* HOM
17. Tub gurnard *Trigla lucerna* (= *Chelidonichthys lucerna*) GUU

Table 2: Additional species not included in the data collection regulations.

Species common name, species scientific name FAO CODE
1. Sargo breams *Diplodus spp.* SRG
2. Axillary seabream *Pagellus acarne* SBA
3. Blackspot seabream *Pagellus bogaraveo* SBR
4. Greater forkbeard *Phycis blennoides* GFB
5. Poor cod *Trisopterus minutus* POD

4.2 Participants

The full list of participants at EWG-11-05 is presented in Annex I to this report.

5 ToR A-E UPDATE AND ASSESS HISTORIC AND RECENT STOCK PARAMETERS (SUMMARY SHEETS)

The following section of the present report does provide short stock specific assessments in the format of summary sheets. Such summary sheets are only provided in cases when the analyses resulted in an analytical assessment of exploitation rate. Unlike earlier years, the assessments are presented in geographic order by GSA, and not any longer by species. The format of the summary sheet has been agreed by the experts in 2008. Detailed versions of the assessments of stocks and fisheries are provided in the following section 6 of the report.

5.1 Summary sheet of European hake (*Merluccius merluccius*) in GSA 01

Species common name:	European hake
Species scientific name	*Merluccius merluccius*
Geographical Sub-area(s) GSA(s):	GSA 01

Most recent state of the stock

- State of the adult abundance and biomass:

Stock assessment has been computed by Length Cohort Analysis (VIT software) using DCF data of landings at length (2008-2009). Medits survey indices show a variable pattern of abundance (n/h) and biomass (kg/h) without a clear trend. Since no precautionary level for the stock of hake in GSA 01 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

- State of the juvenile (recruits):

No data available

- State of exploitation:

EWG 11-05 proposes $F_{0.1} \leq 0.21$ as limit management reference point (F_{MSY} proxy) consistent with high long term yields (F_{MSY} proxy). F was estimated around F=0.96 and F=1.19 in 2008 and 2009, respectively and thus by far exceeds F_{MSY}. Therefore, EWG 11-05 classifies the stock being subject to overfishing.

- Source of data and methods:

Length cohort analysis VIT was computed on data of commercial landings (2008-2009).

Outlook and management advice

EWG 10-05 recommends the relevant fleets' effort to be reduced until fishing mortality is below or at the proposed level F_{MSY}, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plan taking into account mixed-fisheries effects. Catches and effort consistent with F_{MSY} should be estimated.

Short and medium term scenarios:

Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending on data availability.

Fisheries

No particular description is provided. Discards could not be quantified.

DCF landings (t) of hake in GSA 01, 2002-2009.

COUNTRY	YEAR	GEAR	MESH_SIZ	FISHERY	AREA	SPECON	SPECIES	LANDINGS
ESP	2002	OTB	40D50	DEMSP	SA 1	-1	HKE	353.25
ESP	2003	OTB	40D50	DEMSP	SA 1	-1	HKE	201.4966
ESP	2004	OTB	40D50	DEMSP	SA 1	-1	HKE	374.1781
ESP	2005	OTB	40D50	DEMSP	SA 1	-1	HKE	208.3379
ESP	2006	OTB	40D50	DEMSP	SA 1	-1	HKE	212.4689
ESP	2007	OTB	40D50	DEMSP	SA 1	-1	HKE	219.7745
ESP	2008	OTB	40D50	DEMSP	SA 1	-1	HKE	242.1681
ESP	2009	OTB	40D50	DEMSP	SA 1	-1	HKE	488.665

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (mean)	≤ 0.21
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of European hake in GSA 01 can be found in the following section 6.

5.2 Summary sheet of red mullet (*Mullus barbatus*) in GSA 01

Species common name:	Red mullet
Species scientific name	*Mullus barbatus*
Geographical Sub-area(s) GSA(s):	GSA 01

Most recent state of the stock

- State of the adult abundance and biomass:

Stock assessment has been computed by Length Cohort Analysis (VIT software) using DCF data of landings at length (2008-2009). Medits survey indices show a variable pattern of abundance (n/h) and biomass (kg/h) without a clear trend. Since no precautionary level for the stock of red mullet in GSA 01 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

- State of the juvenile (recruits):

No data available

- State of exploitation:

EWG 11-05 proposed $F_{0.1}$=0.52 as limit reference point consistent with high long term yield (F_{msy} proxy). Based on the assessment results (F=1.3), EWG 11-05 assessed the status of the stock of red mullet in GSA 1 as being subject to overfishing.

- Source of data and methods:

Length cohort analysis VIT was computed on data of commercial landings (2008-2009).

Outlook and management advice

EWG 10-05 recommends the relevant fleets' effort to be reduced until fishing mortality is below or at the proposed level F_{MSY}, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plan taking into account mixed-fisheries effects. Catches and effort consistent with F_{MSY} should be estimated.

Short and medium term scenarios:

Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) in accordance with data availability.

Fisheries

No particular description is provided. Landings data were reported to EWG11-05 through the Data collection regulation. Only landings by otter trawlers are considered, which increased from 68 t in 2002 to 154 t in 2009. Discards are considered negligible and range at or below one ton.

Annual landings (t) by fishing technique as reported to EWG11-05 through the DCR data call.

SPECIES	AREA	COUNTRY	FT_LVL4	FT_LVL5	FT_LVL6	2002	2003	2004	2005	2006	2007	2008	2009
MUT	1	ESP	OTB	DEMSP	40D50	68	81	109	94	109	138	113	154

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (mean)	≤ 0.52
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of red mullet in GSA 01 can be found in the following section 6.

5.3 Summary sheet of blue and red shrimp (*Aristeus antennatus*) in GSA 01

Species common name:	Blue and red shrimp
Species scientific name	*Aristeus antennatus*
Geographical Sub-area(s) GSA(s):	GSA 01

Most recent state of the stock

- State of the adult abundance and biomass:

Since no precautionary level for the stock of blue and red shrimp in GSA09 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach. The MEDITS survey indices indicate a very low stock abundance since 2007.

- State of the juvenile (recruits):

No information available.

- State of exploitation:

EWG 11-05 proposed an $F_{0.1} \leq 0.29$ limit reference point (F_{MSY} proxy) and taking into account the results obtained from the LCA analysis (F = 1.32), the stock was considered to be subject to overfishing.

- Source of data and methods:

Length cohort analysis was computed on data of commercial landings (2006-2009).

Outlook and management advice

EWG 10-05 recommends the relevant fleets' effort to be reduced until fishing mortality is below or at the proposed level F_{MSY}, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plan taking into account mixed-fisheries effects. Catches and effort consistent with F_{MSY} should be estimated.

Short and medium term scenarios:

Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending on data availability.

Fisheries

Throughout the time series since 2002, landings fluctuated between 150 and 422 t, with an average of 290 t, with a continuous decreasing trend. No updated information was documented during EWG-05-11. However, this species is known to have no significant discards. No information was documented during EWG-05-11. STECF (stock review part II in 2007) noted that in the GSA 01 there are 140 trawlers, considering shelf and slope activity, and landings are around 400 tonnes by year.

Table 6.3.2.3.1.1 Landings of blue and red shrimp in GSA 01.

AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007	2008	2009
1	ESP	OTB	339.627	422.673	346.253	283.988	371.231	216.781	150.323	184.414

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (mean)	≤ 0.29
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of blue and red shrimp in GSA 01 can be found in the following section 6.

5.4 Summary sheet of blue and red shrimp (*Aristeus antennatus*) in GSA 09

Species common name:	Blue and red shrimp
Species scientific name	*Aristeus antennatus*
Geographical Sub-area(s) GSA(s):	GSA 09

Most recent state of the stock

- State of the adult abundance and biomass:

Stock assessment has been computed by Length Cohort Analysis (VIT software) using DCF data of landings at age (2006-2009). Results obtained did not show a clear trend in the stock size. Medits survey indices indicate a variable pattern of abundance (n/h) and biomass (kg/h) without a clear trend. In the period analyzed (2006-2009) abundance indices showed a stationary phase followed by an increase in 2009 while biomass indices showed a decrease in the same year. Since no precautionary level for the stock of blue and red shrimp in GSA09 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

- State of the juvenile (recruits):

Medits length frequency distributions and length at age of the commercial landings showed that between 2008 and 2009 a large year class was estimated in the area.

- State of exploitation:

EWG 11-05 proposed an $F_{0.1} \leq 0.32$ limit reference point (F_{MSY} proxy) and taking into account results coming from the LCA analysis (average F= 0.52), the stock was considered to be subject to overfishing.

- Source of data and methods:

Length cohort analysis was computed on DCF data of commercial landings (2006-2009). Landings per age were obtained splitting LFD respects on the following growth parameters CL_∞=76.9 cm, K=0.21. Length-weight relationship coefficients were a=0.0029 and b=2.449. Natural mortality vector was estimated by PRODBIOM.

• **Growth**
$L\infty$ =76.9 mm carapace length
K = 0.21
t0 = 0
• **Length-Weight relationships**
a = 0.0029
b = 2.449
• **Natural mortality**
Mvector = 0.75 (age 1), 0.49 (age 2), 0.40 (age 3), 0.36 (age 4),0.33 (age 5), 0.32 (age 6), 0.30 (age 7), 0.29 (age 8), 0.29 (age 9), 0.28 (age 10)
• **Length maturity**
L_{50}=35mmCL

Outlook and management advice

EWG 10-05 recommends the relevant fleets' effort to be reduced until fishing mortality is below or at the proposed level F_{MSY}, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plan taking into account mixed-fisheries effects. Catches and effort consistent with F_{MSY} should be estimated.

Short and medium term scenarios:

Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending on data availability.

Fisheries

The blue and red shrimp represent one of the most valuable demersal resources for the trawling fleet operating on the muddy bottoms of the upper and middle slope up to 750-800m depth. More than 95% of GSA annual landings were observed in the northern part of the area and there was not discards. Annual landings did not show a trend from 2002 to 2009 but an increasing trend from 2007 onward was detected. Nominal effort (kW*days) decreased from 2005 until 2009, reflecting an increasing in LPUE in the last 2 years.

Annual landings (t) by fishing technique in GSA09 (2004-2009)

Country	Area	Species	Year	Gear	Fishery	Landings	Total landings
ITA	09	ARA	2004	OTB	MDDWSP	82	82
			2005		MDDWSP	154	154
			2006		MDDWSP	93	93
			2007		MDDWSP	47	47
			2008		DWSP	31	64
			2008		MDDWSP	33	
			2009		DWSP	69	123
			2009		MDDWSP	54	

Fishing effort (kW*days) by fishing technique in GSA09 (2004-2009)

Country	Area	Species	Year	Gear	Fishery	Effort	Total effort
ITA	09	ARA	2004	OTB	MDDWSP	7976571	7986777
			2004		DWSP	10206	
			2005		MDDWSP	12729333	12729333
			2006		MDDWSP	9684257	9684257
			2007		MDDWSP	8755987	8755987
			2008		DWSP	221689	2652398
			2008		MDDWSP	2430709	
			2009		DWSP	485798	2504493
			2009		MDDWSP	2018695	

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (mean)	≤ 0.32
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of blue and red shrimp in GSA09 can be found in the following section 6.

5.5 Summary sheet of spottail mantis shrimp (*Squilla mantis*) in GSA 09

Species common name:	Spottail mantis shrimp
Species scientific name	*Squilla mantis*
Geographical Sub-area(s) GSA(s):	GSA 09

Most recent state of the stock

- <u>State of the adult abundance and biomass:</u>

EWG 11-05 is unable to fully evaluate the status of the stock size as no precautionary reference point is defined. The analyses performed give a SSB estimation of 368 tons in 2009. The Medits survey indicates recent fluctuations without a clear trend in stock abundance.

- <u>State of the juvenile (recruits):</u>

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment. The analyses performed give an estimation of 117×10^6 recruits in 2009.

- <u>State of exploitation:</u>

EWG 11-05 proposes $F_{0.1} \leq 0.64$ as limit management reference point consistent with high long term yields (F_{MSY} proxy). The current F=1.35 estimated for 2009 is above the Y/R $F_{0.1}$ reference point (0.64), which indicates that mantis shrimp in GSA 09 is subject to overexploitation. EWG 11-05 recommends reducing fishing mortality towards the proposed reference point F_{MSY}. This can be done by reducing fishing effort of the relevant fleets taking into account mixed-fisheries effects. Catch forecasts consistent with the adopted measures shall be estimated. EWG 11-05 emphasizes that this is the first attempt to evaluate the exploitation state of the species and, therefore, it is necessary to analyze a longer data series in order to confirm the results obtained for 2009.

- <u>Source of data and methods:</u>

Data used derive from commercial catches (landing and discard) by size and age. A cohort analysis was performed with VIT using commercial catches for the year 2009 and to estimate *F*, the value of the $F_{0.1}$, the numbers at age and other features.

The main parameters used are:

Growth parameters (Von Bertalanffy)
L□ = 41.0 (mm, carapace length)
K = 0.5
to =
L*W
a = 0.099
b = 1.737
Natural mortality
M vector Age_1=1.42 , Age_2=0.63, Age_3=0.48, Age_4=0.41, Age_5=0.37, Age_6=0.36
Length at maturity (L_{50})
L_{50} = 20.0 mm CL

Outlook and management advice

EWG 11-05 recommends to reduce fishing mortality towards the proposed reference point F_{MSY} in order to avoid future losses in stock productivity and landings. This can be done by reducing fishing effort of the relevant fleets by means of a multi-annual management plan taking into account mixed-fisheries effects. Catches and effort consistent with F_{MSY} should be estimated. Spottail mantis shrimp is a by-catch species in the mixed trawl fishery carried out in GSA 9. This is the first assessment for the species in GSA 9 done with the best available information. Further analysis including more years will be necessary to confirm the results obtained for 2009.

<u>Short and medium term scenarios:</u>

Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending on data availability.

Fisheries

Although the species is exploited by different types of gears, the majority of the landings come from trawling. The annual landings for 2009 were due for 95% to bottom trawl (381 tons), for 2.25% to Gillnet (9 tons) and for 2.25% to trammel net (9 tons). Discards represented in 2009 3.4% of the trawling total catch (13.3 tons). About 200 bottom trawlers operate in the area, but is not possible an exact quantification of the fraction of them that exploit this resource in the coastal area. Spottail mantis shrimp is a coastal species, which is caught as a part of a species mix that constitutes the target of the trawlers operating near shore. The main species caught in GSA9 are *Sepia officinalis, Trigla lucerna, Merluccius merluccius, Mullus barbatus, O. vulgaris.* Trawl catch is mainly composed by age 1 and 2 individuals while the older age classes are poorly represented in the catch. As concerns artisanal fisheries, *S. mantis* is a by-catch of gillnets and trammel nets targeting other species in the coastal area.

The total landings showed a decreasing trend in the period 2004-2009, with a maximum value in 2005 (590 tons) and minimum in 2008 (394 tons). The species is mainly landed by the trawl fleet fishing on the continental shelf and on the upper part of the continental slope. A fluctuating trend in the landing of OTB is observed, with lower values in the last two years. This trend seems to be mainly due to the reduction in fishing effort observed for this type of gear, while the LPUEs remained quite constant during the period analysed. The decreasing trend in the landings is more evident for artisanal gears. In 2009 the landings of gillnets and trammel nets was 18 tons, representing only the 4.5% of the total landings of the species. The LPUEs for these two gears shown a significant reduction, particularly evident in the case of gillnets.

Total catches (in tons) of *Squilla mantis* by gear

	2004	2005	2006	2007	2008	2009
Otter trawl	449	436	356	432	354	381
Gillnet	98	132	96	51	34	9
Trammel net	28	22	26	9	6	9
Total	575	590	478	492	394	399

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (mean)	≤ 0.64
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of spottail mantis shrimp in GSA09 can be found in the following section 6.

5.6 Summary sheet of striped red mullet (*Mullus surmuletus*) in GSA 09

Species common name:	Striped red mullet
Species scientific name	*Mullus surmuletus*
Geographical Sub-area(s) GSA(s):	GSA 09

Most recent state of the stock

- <u>State of the adult abundance and biomass:</u>

EWG 11-05 is unable to fully evaluate the status of the stock size as no precautionary reference point is defined. The analyses performed give a SSB estimation of 335 tons in 2009. The Medits survey indicates recent fluctuations without a clear trend in stock abundance. However, the recent estimates indicate a low stock size in 2008 and 2009.

- <u>State of the juvenile (recruits):</u>

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment. The analyses performed give an estimation of 5.8×10^6 recruits in 2009.

- <u>State of exploitation:</u>

EWG 11-05 proposes $F_{0.1} \leq 0.31$ as limit management reference point consistent with high long term yields (F_{MSY} proxy). The current F=0.71 in 2009 exceeds F_{MSY} reference point, which indicates that striped red mullet in GSA 09 is subject to overfishing.

- <u>Source of data and methods:</u>

Data used derive from commercial catches (landing and discard) by size and age. A cohort analysis with VIT using commercial catches for the year 2009 was performed to estimate *F*, the value of the $F_{0.1}$, the numbers at age and other features.

The main parameters used are:

Growth parameters (Von Bertalanffy)
L□ = 32.0 (cm, total length, TL)
K = 0.43
to = -0.70
L*W
a = 0.01
b = 3.103
Natural mortality
M vector Age_0=0.49 , Age_1=0.26, Age_2=0.22, Age_3=0.20, Age_4=0.19, Age_5=0.18, Age_6=0.18 , Age_1=0.17
Length at maturity (L_{50})
L_{50} = 11.5 cm TL

Outlook and management advice

EWG 11-05 recommends reducing fishing mortality towards the proposed reference point F_{MSY}. This can be done by reducing fishing effort of the relevant fleets and by adopting larger mesh for small-scale fishery. Catches and effort consistent with F_{MSY} should be estimated. However, this is the first assessment for Striped red mullet in GSA 9, and it is necessary to conduct further analysis on other years to confirm the results obtained for 2009.

As striped red mullet is mainly caught by different gears and in mixed fisheries, the measures adopted to reduce fishing mortality require multi-annual management plans being developed and fully implemented.

<u>Short and medium term scenarios:</u>

Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending on data availability.

Fisheries

The species is exploited by different types of gears. The annual landing for 2009 was due for 30% to bottom trawl (75 tons), for 31% to gillnet (76 tons) and for 39% to trammel net (96 tons). Discard is quite negligible and occurs only for trawling (0.8 tons in 2009). About 200 bottom trawlers exploit this resource all year round in the coastal area frequently using specific devices to exploit hard bottoms where the species is more abundant. Striped red mullet is caught as a part of a species mix that constitutes the target of the trawlers operating near shore. The main species caught in GSA9 are *Squilla mantis, Sepia officinalis, Trigla lucerna, Merluccius merluccius, Mullus barbatus, Z. faber.* The length of first capture is of about 12 cm. Trawl catch is mainly composed by age 0+ individuals while the older age classes are poorly represented in the catch.

As concerns artisanal fisheries, *M. Surmuletus* is caught by gillnet and trammel net. In some period of the year (end of spring-summer), the species represents the target of the artisanal fishery. In particular, part of the fleet uses a small mesh size trammel net to catch it on rocky bottoms near the shore. The catch is mainly composed by individuals at ages 0+ and 1.

The landing showed a clear decreasing trend in the period 2004-2009, with maximum value in 2005 (404 tons) and minimum in 2008 (224 tons). It is difficult to correlate this decline with the reduction in fishing effort as it is not possible to quantify the real effort exerted by the fleet on this resource. However, the LPUEs calculated on the entire fleet show considerable fluctuations with a decreasing trend, particularly evident for the gillnet.

Total catches (in tons) of *Mullus surmuletus* by gear

	2004	2005	2006	2007	2008	2009
Otter trawl	94	143	78	60	58	78
Gillnet	142	139	143	188	80	76
Trammel net	136	122	152	74	86	96
Total	372	404	373	322	224	250

Limit and precautionary management reference points

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (mean)	≤ 0.31
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of striped red mullet in GSA 9 can be found in section 6 of this report.

5.7 Summary sheet of blackmouth catshark (*Galeus melastomus*) in GSA 09

Species common name:	Blackmouth catshark
Species scientific name	*Galeus melastomus*
Geographical Sub-area(s) GSA(s):	GSA 09

Most recent state of the stock

- State of the adult abundance and biomass:

Medits survey indices show a variable pattern of stock size without a clear trend. Since no precautionary level for the stock of blackmouth catshark in GSA 09 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

- State of the juvenile (recruits):

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment.

- State of exploitation:

EWG 11-05 proposes $F_{0.1} \leq 0.12$ as limit management reference point consistent with high long term yields (F_{MSY} proxy). The species is considered overexploited, with consistent diagnosis of the current exploitation status obtained with the 2 used approaches aimed at the definition of precautionary Reference Points (F_c = 0.25 and $F_{0.1}$=0.12) which values are much lower than the current estimate of fishing mortality rate of F=0.4. The size of first capture is too small (growth overfishing) and an increase in yield and a more safe situation for the stock as regards the possibility of self-renewal can be expected in the case a reduction of fishing effort do occur and/or more selective gears are used.

- Source of data and methods:

The analyses were performed using the information of abundance and size frequencies proceeding from trawl surveys, size structure of commercial landings (year 2009) and data of landed and discarded fractions from data collected by observers on board. A length cohort analysis allowed the estimation of the current fishing mortality rate and numbers at sea.

The main parameters used are:

Von Bertalanffy growth parameters $L\infty$=64; K=0.15; to=0
Length/weight relationship a=0.0025 b=3.02
M=0.25

Outlook and management advice

EWG 11-05 recommends reducing fishing mortality towards the proposed reference point F_{MSY}. This can be done by reducing fishing effort of the relevant fleets and a review of appropriate technical measures and a full implementation of these.

As blackmouth catshark is mainly caught by different gears and in mixed fisheries, the measures adopted to reduce fishing mortality require multi-annual management plans being developed and fully implemented.

Short and medium term scenarios:
Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending on data availability.

Fisheries

This deep sea species is mainly distributed in the depth range 200-1000m. It has a low commercial interest. Only relatively big-sized individuals are landed. It is caught as by-catch mainly in the Norway lobster and Red shrimps fisheries, by vessels operating within the dept range 250-500m and 500-800m respectively . Other involved species of the fishery are *Phycis blennoides, Micromesistius potassou, Lepidopus caudatus, Trachurus trachurus, Conger conger, Macrouridae, Etmopterus spinax, Gadiculus argenteus, Parapenaeus longirostris.*

Annual landings are very low (<10 t in 2009) and show a high seasonal variability, with peaks in the 2nd and 3rd trimesters. High discard rates are likely.

Limit and precautionary management reference points

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (mean)	≤ 0.12
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of blackmouth catshark in GSA 9 can be found in section 6 of this report.

5.8 Summary sheet of pink shrimp (*Parapaeneus longirostris*) in GSA 11

Species common name:	Pink shrimp
Species scientific name	*Parapaeneus longirostris*
Geographical Sub-area(s) GSA(s):	GSA 11

Most recent state of the stock

- State of the adult abundance and biomass:

SSB indices from Medits survey showed a decreasing trend during the last 10 years with the highest value in 1999. Since no precautionary level for the stock of pink shrimp in GSA 11 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

- State of the juvenile (recruits):

Recruitment indices show a consistent decline since 1999 with some variation to a very low level in 2007-2009.

- State of exploitation:

EWG 11-05 proposes $F_{0.1} \leq 0.82$ as limit management reference point consistent with high long term yields (F_{MSY} proxy). According to the F estimates obtained by applying SURBA routines to MEDITS trawl surveys indices, fishing mortality has declined since 2002. The F estimate through LCA on the last year of landing data (2009) amounts to $F_{1\text{-}3} = 0.86$, which is just below the estimated reference value of $F_{0.1}$=0.89. Given the data constraints in commercial fisheries data (shortage) and the pronounced changes in population parameters as indicated from the MEDITS survey, EWG 11-05 is unable to conclude on the exploitation status of the stock.

- Source of data and methods:

Both indirect (fisheries monitoring) and direct (scientific surveys) data sources were utilized. Time series of survey data were used (MEDITS: 1994-2009) to investigate trends in abundance and F with SURBA. Length Cohort Analysis was used on 2009 DCR landing data. SURBA and VIT analyses were conducted to estimate stock parameters. In particular reference points were assessed by applying a VIT Yield and Spawning Stock Biomass per Recruit analysis and Yield packages.

In terms of data quality and availability, Medits survey data were available from 1994 to 2009. No data were available for 2010. Data on size composition of landings from commercial fisheries were limited to one year only.

Outlook and management advice

Although reliable fishing mortality could not be estimated, EWG 11-05 advises to reduce the fishing effort directed towards pink shrimp. This advice is based on the indicated decrease and recent low stock size and recruitment.

Short and medium term scenarios:

Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending data availability.

Fisheries

The species is only exploited by trawlers, which operates in all seas surrounding the island. Fishing grounds are typical muddy bottoms from 150 to 570 m depth, but the occurrence of the species is mainly between 200 and 450 meter of depth.

P. longirostris is generally caught together with other important commercial species such as *Nephrops norvegicus*, *Merluccius merluccius*, *Eledone cirrhosa*, *Illex coindetii*, *Todaropsis eblanae, Helicolenus dactylopterus, Phycis blennoides, Micromesistius poutassou, Lophius sp*. and some other minor species such as *Glossanodon leioglossus, Capros aper, Galeus melastomus* and *Raja sp*.

Trawl landings peak to 552 tons in 2005 and declined rapidly to 42 tons in 2009.

Annual landings (t) by fishing technique in GSA11 as provided through the official DCF data call 2010.

FT_LVL4	2004	2005	2006	2007	2008	2009
GTR		3.98	2.74			
OTB	232	548	127	79.4	45.8	42.6
total landings	232	552	130	79.4	45.8	42.6

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (1-3)	≤ 0.82
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of pink shrimp in GSA 11 can be found in section 6 of this report.

5.9 Summary sheet of common sole (*Solea solea*) in GSA 17

Species common name:	Common sole
Species scientific name	*Solea solea*
Geographical Sub-area(s) GSA(s):	GSA 17

Most recent state of the stock

- State of the adult abundance and biomass:

SSB indices from SoleMon surveys showed a decreasing trend during 2005-2009 and the SSB index remained at the lowest level in 2010. Since no precautionary level for the stock of pink shrimp in GSA 11 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

- State of the juvenile (recruits):

Recruitment varied without any trend in the years 2005-2010, reaching a minimum in 2010.

- State of exploitation:

The following statements by EWG 11-05 are conditional of the assumption that the survey based selection patterns is not significantly different from the fisheries' selection patterns.

EWG 11-05 proposes $F_{0.1} \leq 0.26$ as limit management reference point consistent with high long term yields (F_{MSY} proxy). Based on the SURBA and catch curve analyses, estimates of the fishing mortality in 2010 amount to $F_{0\text{-}4}$=1.15 and F=1.23, respectively, which by far exceed the proposed reference point. EWG 11-05 concludes that the resource is subject to overfishing.

- Source of data and methods:

The previous assessments, presented also in the framework of SAC-GFCM, were based on fishery dependent data provided by SoleMon project, because DCF data were not suitable for the analyses. EWG 11-05 has updated the assessment carried out during the SGMED-10-02 only with 2010 survey data, because data from SoleMon project and DCF were not available during the meeting. The present assessment is based on SURBA model. Data used for SURBA:

- abundance indexes data by age and years (2005-2010) from SoleMon survey.
- biological sampling 2005-2009 for maturity at age and length-weight relationships.
- M vector, estimated using PROBIOM.
- data derived from a regional project (SoleMon) founded by MIPAF and ADRIAMED. Length data were transformed to age data by slicing (LFDA 5.0) using the parameters estimated by length-frequency distributions from surveys (L_{inf}: 39.6 cm; k: 0.44 y^{-1}; t_0: -0.46 y). Discard of *S. solea* is negligible (also damaged specimens are sold at a lower price).

Outlook and management advice

EWG 11-05 recommends reducing fishing mortality towards the proposed reference point F_{MSY}. This can be done by reducing fishing effort of the relevant fleets and a review of appropriate technical measures and a full implementation of these. A specific multi-anuual management plan considering multi-species effects and a set of specific rules for rapido trawl fishery would be advisable (e.g.: size and number of gears, mesh size, towing speed, spatial and/or temporal closure). A two–months closure for rapido trawling inside 11 km off-shore along the Italian coast, after the biological fishing ban (August), may be considered to reduce the portion of juvenile specimens in the catches (sensitive period).

Short and medium term scenarios:
Short and medium term predictions of stock biomass and catches will be accomplished during the two follow-up meetings (26-30 September 2011 and 16-20 January 2012, respectively) depending on data availability.

Fisheries

The Italian fleets exploit this resource with *rapido* trawl and set nets (gill nets and trammel nets), while only trammel net is used in the countries of the eastern coast of GSA 17 in the Adriatic Sea. Sole is an accessory species for otter trawling. More than 90% of catches are caught in the Italian side of the GSA 17. Landings fluctuated between 1,000 and 2,300 t in the period 1996-2006 (data source: FAO-FishStat and ISMEA-SISTAN time series). The fishing effort applied by the Italian *rapido* trawlers gradually increased from 1996 to 2005, and slightly decreased in the last years.

Brief description of trends: Exploitation is based on young age classes, mainly 1 and 2 year old individuals, with immature fraction dominating the landings. In the last years, the annual landings of this species were around 2184 tons in the overall GSA. From SoleMon project data, carried out in a portion of the GSA17 (from San Benedetto del Tronto to Triest), the Italian fleet exploiting sole is made up by around 1,300 vessels. Otter and rapido trawlers carry out their activity all year round, with the only exception of the fishing ban (end of July – beginning of September), while set netters show a seasonal activity (spring-fall). The fishing grounds exploited by rapido trawlers extend from 5.5 km from the shoreline to 50-60 m depth, while otter trawlers carry out their activity in the overall area, except for the Croatian waters. Set netters usually operate in the shallower waters usually close to the fishing harbors.

Limit and precautionary management reference points

Table of limit and precautionary management reference points proposed by STECF EWG 11-05

$F_{0.1}$ (0-4)	≤ 0.26
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and precautionary management reference points agreed by fisheries managers

$F_{0.1}$ (mean)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The detailed assessment of common sole in GSA 17 can be found in section 6 of this report.

6 ToR A-E UPDATE AND ASSESS HISTORIC AND RECENT STOCK PARAMETERS (DETAILED ASSESSEMENTS)

The following section of the present report does provide detailed stock specific assessments and all relevant data of such stocks and their fisheries. Unlike earlier years, the assessments are presented in geographic order by GSA, and not any longer by species. The format of the assessments has been agreed by the experts in 2008. Short versions of the assessments of stocks and fisheries in the format of summary sheets are provided in the preceding section 5.1 in cases when the analyses resulted in an analytical assessment of exploitation rate.

6.1 Stock assessment of hake in GSA 01

6.1.1 Stock identification and biological features

6.1.1.1 Stock Identification

No information was documented during EWG-05-11. The delimitation of the hake stock in GSA01 is considered largerly unknown. Likely connections with hake in GSA06 may exist, because of the continuity of shelf. Large exchanges with the south Alboran Sea (GSA03) are believed insignificant.

6.1.1.2 Growth

No information was documented during EWG-05-11.

6.1.1.3 Maturity

No information was documented during EWG-05-11.

6.1.2 Fisheries

6.1.2.1 General description of fisheries

No information was documented during EWG-05-11.

6.1.2.2 Management regulations applicable in 2010 and 2011

No information was documented during EWG-05-11.

6.1.2.3 Catches

6.1.2.3.1 Landings

The following table shows the trend in landings as obtained from the DCF data call in 2010.

Table 6.1.2.3.1.1 DCF landings (t) of hake in GSA 01, 2002-2009.

COUNTRY	YEAR	GEAR	MESH_SIZ	FISHERY	AREA	SPECON	SPECIES	LANDINGS
ESP	2002	OTB	40D50	DEMSP	SA 1	-1	HKE	353.25
ESP	2003	OTB	40D50	DEMSP	SA 1	-1	HKE	201.4966
ESP	2004	OTB	40D50	DEMSP	SA 1	-1	HKE	374.1781
ESP	2005	OTB	40D50	DEMSP	SA 1	-1	HKE	208.3379
ESP	2006	OTB	40D50	DEMSP	SA 1	-1	HKE	212.4689
ESP	2007	OTB	40D50	DEMSP	SA 1	-1	HKE	219.7745
ESP	2008	OTB	40D50	DEMSP	SA 1	-1	HKE	242.1681
ESP	2009	OTB	40D50	DEMSP	SA 1	-1	HKE	488.665

6.1.2.3.2 Discards

No information was documented during EWG-05-11.

6.1.2.3.3 Fishing effort

No information was documented during EWG-05-11.

6.1.3 Scientific surveys

6.1.3.1 MEDITS

6.1.3.1.1 Methods

Based on the DCR data call, abundance and biomass indices were recalculated. In GSA01 the following number of hauls was reported per depth stratum (Tab. 6.1.3.1.1.1).

Tab. 6.1.3.1.1.1. Number of hauls per year and depth stratum in GSA01, 1994-2010.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GSA01_010-050	2	1	2	2	2	2	2	3	3	3	3	2	3	3	4	2	3
GSA01_050-100	5	4	5	5	5	7	6	4	6	10	7	7	6	6	6	7	6
GSA01_100-200	3	3	3	5	5	5	5	4	8	6	5	6	5	6	6	6	4
GSA01_200-500	7	9	11	10	7	11	12	10	11	11	13	11	11	11	11	11	6
GSA01_500-800	6	9	12	10	12	12	9	13	13	14	13	11	15	10	7	5	6

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Catches by haul were standardized to 60 minutes hauling duration. The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$
$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$
Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval:
Confidence interval = Yst ± t(student distribution) * V(Yst) / n

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA.

6.1.3.1.2 Geographical distribution patterns

No information was documented during EWG-05-11.

6.1.3.1.3 Trends in abundance and biomass

Fishery independent information regarding the state of the blue and red shrimp in GSA09 was derived from the international survey MEDITS. Figure 6.1.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 01. The estimated abundance and biomass indices do not reveal a clear trend.

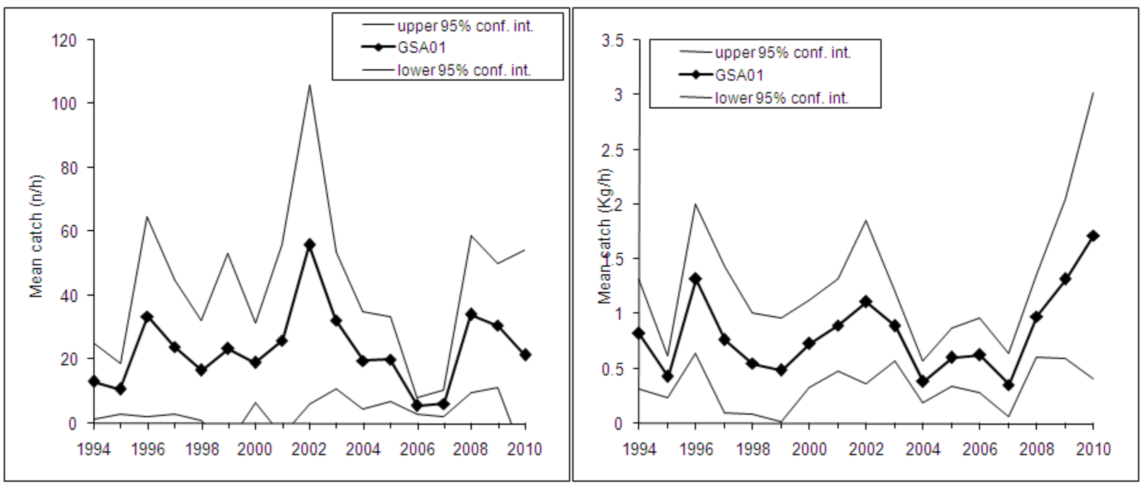


Fig. 6.1.3.1.3.1 Abundance and biomass indices of hake in GSA 01.

6.1.3.1.4 Trends in abundance by length or age

No information was been documented.

6.1.3.1.5 Trends in growth

No information was been documented.

6.1.3.1.6 Trends in maturity

No information was been documented.

6.1.4 Assessments of historic stock parameters

6.1.4.1 Method 1: LCA

6.1.4.1.1 Justification

The pseudo-cohort analysis VIT was applied using data from 2008 and 2009.

6.1.4.1.2 *Input parameters*

The biological data to condition the VIT analysis are defined as follows:

Growth parameters used were those from Garcia-Rodriguez \(2003) over length distribution analysis (Linf= 106.7; K 0.20; t0= 0.0028) and length-weight relationship (a= 0.00486; b= 3.118).

Maturity ogive was taken from García Rodriguez and Esteban (1995), with size at first maturity (50 %) at 33 cm TL.

Age class	0	1	2	3	4	5
Maturity ratio	0	0.145328	0.8175767	0.9838565	1	1

The length frequencies of landings are illustrated in the following Figure 6.1.4.3.2.1. The length frequencies on the period 2002 to 2009, show a first modal value between 12 and 15 cm, especially clear in 2006, and another modal class around 20 cm, which moved to the 25 cm in the last year (2009).

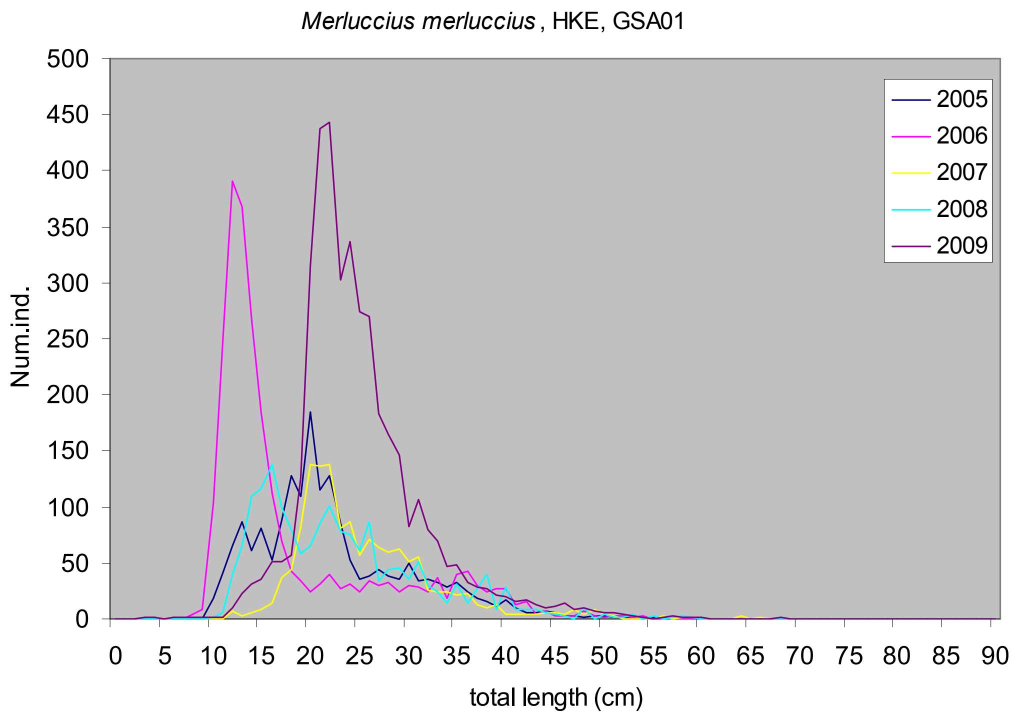


Figure 6.1.4.3.2.1. Landing sizes of hake in GSA 01 during 2005-2009.

6.1.4.1.3 *Results*

The total stock biomass ranged between 224 and 414 tonnes in 2008 and 2009, respectively. SSB ranged between 87 and 144 tonnes, while the average catch was 288 tonnes. Total biomass and SSB show big differences from one year to another, almost doubling the values.

Recruits (aged 0 individuals) were estimated to have a value of 4.6 and 10.8 ind.*10^6 in 2008 and 2009.

Fishing mortality acts especially over ages 1-3, declining thereafter. Average fishing mortality of all ages is estimated to range at 0.96-1.19 (Fig. 6.1.4.3.1.1).

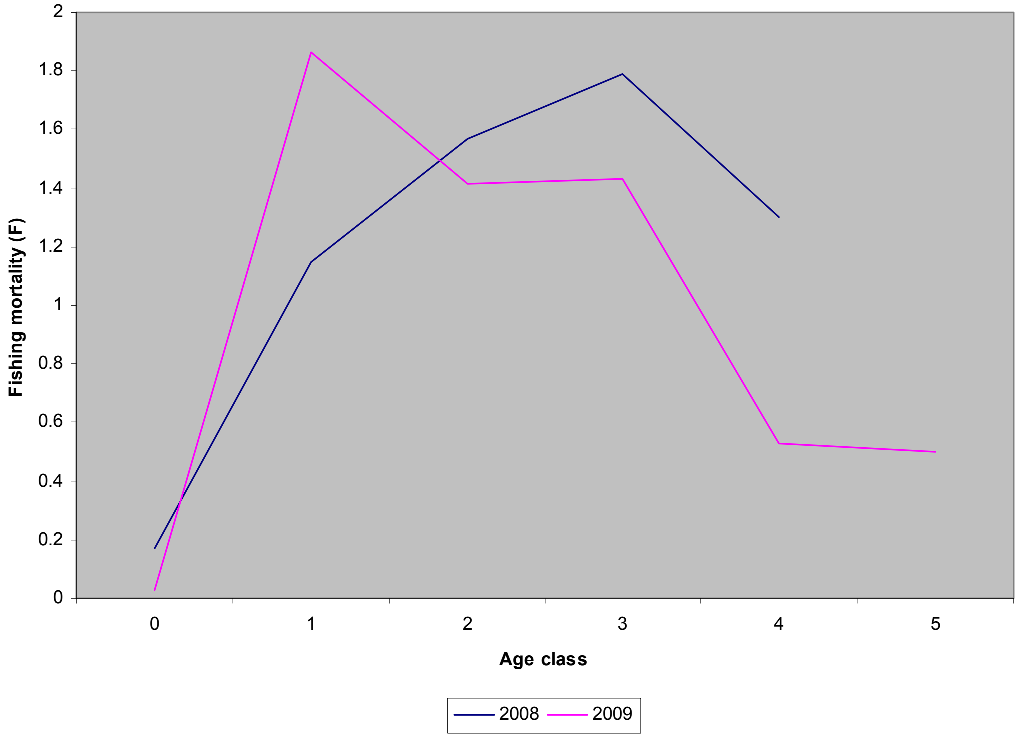


Fig. 6.1.4.3.1.1 Fishing mortality over ages as estimated for 2008 and 2009.

6.1.5 Long term prediction

6.1.5.1 Justification

The yield per recruit from the VIT was applied.

6.1.5.2 Input parameters

The length frequency data from 2008 and 2009 and the biological parameters were used as given in table 6.1.6.2.1.

Table 6.1.5.2.1. Input parameters to the yield per recruit analysis, separately for 2008 and 2009.

		2008				
age min	age group	stock weight	catch weight	maturity	F	M
0	0	0.007519	0.007519	0	0.168	1.43
age max	1	0.12574	0.12574	0.145328	1.146	0.68
4	2	0.486421	0.486421	0.8175767	1.57	0.4721
Fref	3	1.09011	1.09011	0.9838565	1.789	0.41722213
1.1900	4	1.9066	1.9066	1	1.3	0.38889347
		2009				
age min	age group	stock weight	catch weight	maturity	F	M
0	0	0.007924	0.007924	0	0.027	1.43
age max	1	0.113669	0.113669	0.145328	1.864	0.68
5	2	0.492091	0.492091	0.8175767	1.413	0.4721
Fref	3	1.107963	1.107963	0.9838565	1.432	0.41722213
0.9600	4	1.957371	1.957371	1	0.526	0.38889347
	5	2.843656	2.843656	1	0.5	0.37270081

6.1.5.3 Results

Y/R value is of 0.028 kg, at the F value of reference of 0.96-1.19; $F_{0.1}$ was established at 0.21 while Fmax was 0.33.

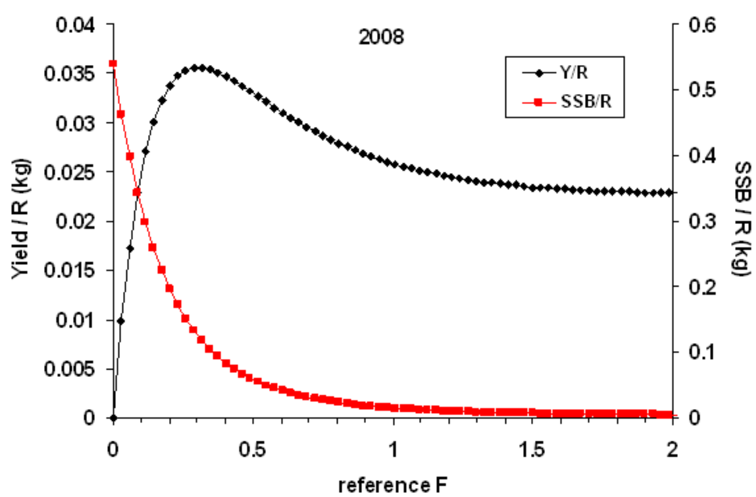


Fig. 6.1.5.3.1.1 YpR analysis for hake in GSA 1 in 2008.

6.1.6 Data quality

The major shortfall is that fishing effort data have not been provided.

6.1.7 Scientific advice

6.1.7.1 Short term considerations

6.1.7.1.1 State of the stock size

Stock assessment has been computed by Length Cohort Analysis (VIT software) using DCF data of landings at age (2008-2009). Medits survey indices show a variable pattern of abundance (n/h) and biomass (kg/h) without a clear trend. Since no precautionary level for the stock of hake in GSA 01 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

6.1.7.1.2 State of recruitment

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment.

6.1.7.1.3 State of exploitation

EWG 11-05 proposes $F_{0.1} \leq 0.21$ as limit management reference point consistent with high long term yields (F_{MSY} proxy).

According to the F=0.96 and F=1.19 estimates of 2008 and 2009, respectively in excess of $F_{0.1}$, the stock does not appear to be able to sustain the current level of fishing effort in the GSA09 and thus EWG 11-05 classifies the stock being subject to overfishing.

6.2 Stock assessment of red mullet in GSA 01

EWG11-05 assessed this stock in 2011 and used as input data DCF data on ages and the same parameters used for this species during SGMED-10-02 for SA05 and 06.

6.2.1 Stock identification and biological features

6.2.1.1 Stock Identification

No information was documented during EWG11-05.

6.2.1.2 Growth

No information was documented during EWG11-05.The parameters are the following: L_{inf}=29.0, K=0.6, t_0=-0.1. Length-weight relationships: a=0.0053, b=3.112 (data source: DCF).

6.2.1.3 Maturity

No new information was presented during EWG-05-11. Adopted from SGMED 2008 were

Age	0	1	2	3
Maturity	0,46	0,76	0,88	0,93

6.2.2 Fisheries

6.2.2.1 General description of fisheries

No updated information was available to EWG11-05. Red mullets are among the most important target species for the trawl fisheries but are also caught with set gears, in particular trammel-nets and gillnets. From official data, the total trawl fleet of the geographical sub-area 01 (Northern Alboran Sea region) is composed by about 170 boats: on average, 42 TRB, 60 GT and 197 HP (in 2007). Smaller vessels operate almost exclusively on the continental shelf (target in red mullets, octopuses, hake and sea breams), bigger vessels operate almost exclusively on the continental slope (targeting decapod crustaceans) and the remaining can operate indistinctly on the continental shelf and slope fishing grounds. Red mullet is intensively exploited during its recruitment from August to November.

6.2.2.2 Management regulations applicable in 2010 and 2011

No information was documented during EWG-05-11.

6.2.2.3 Catches

6.2.2.3.1 Landings

Landings data were reported to EWG11-05 through the Data collection regulation. Only landings by otter trawlers are considered, which increased from 68 t in 2002 to 154 t in 2009.

Table 6.2.2.3.1.1. Annual landings (t) by fishing technique as reported to EWG11-05 through the DCR data call.

SPECIES	AREA	COUNTRY	FT_LVL4	FT_LVL5	FT_LVL6	2002	2003	2004	2005	2006	2007	2008	2009
MUT	1	ESP	OTB	DEMSP	40D50	68	81	109	94	109	138	113	154

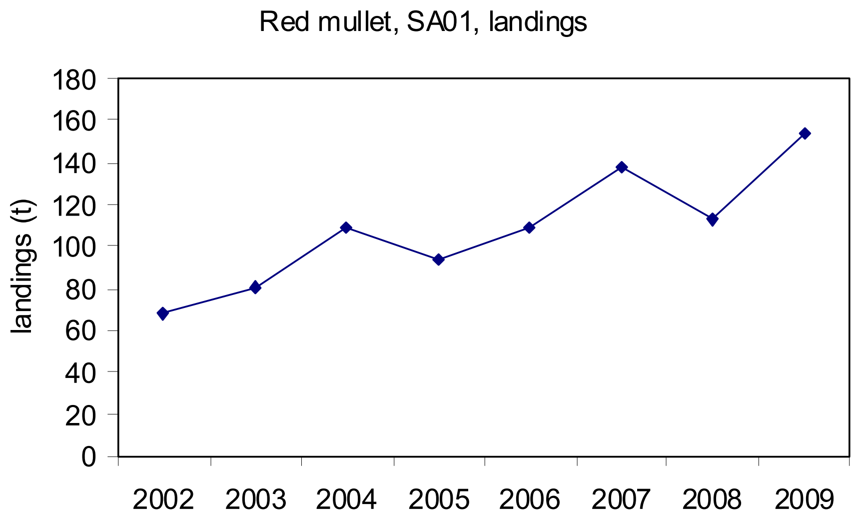


Fig. 6.2.2.3.1.1. Annual landings (t) by fishing technique as reported to EWG11-05 through the DCR data call.

6.2.2.3.2 Discards

There is information on discards for 2005, 2008 and 2009. The amount of discards reported is low (0 t in 2005, 0.1 t in 2008 and 1 t in 2009). There are no data on length or age for these discards.

6.2.2.3.3 Fishing effort

No information was documented during EWG-05-11.

6.2.3 Scientific surveys

6.2.3.1 MEDITS

6.2.3.1.1 Methods

Based on the DCR data call, abundance and biomass indices were recalculated. In GSA01 the following number of hauls was reported per depth stratum (Tab. 6.1.3.1.1.1).

Tab. 6.1.3.1.1.1. Number of hauls per year and depth stratum in GSA01, 1994-2010.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GSA01_010-050	2	1	2	2	2	2	2	3	3	3	3	2	3	3	4	2	3
GSA01_050-100	5	4	5	5	5	7	6	4	6	10	7	7	6	6	6	7	6
GSA01_100-200	3	3	3	5	5	5	5	4	8	6	5	6	5	6	6	6	4
GSA01_200-500	7	9	11	10	7	11	12	10	11	11	13	11	11	11	11	11	6
GSA01_500-800	6	9	12	10	12	12	9	13	13	14	13	11	15	10	7	5	6

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Catches by haul were standardized to 60 minutes hauling duration. The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean
The variation of the stratified mean is then expressed as the 95 % confidence interval:
Confidence interval = Yst ± t(student distribution) * V(Yst) / n

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA.

6.2.3.1.2 Geographical distribution patterns

No information was documented during EWG-05-11.

6.2.3.1.3 Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 01 was derived from the international survey Medits and was compiled in the SGMED-10-02 report. Figure 6.2.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 01.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices since 2004 appear high but are subject to high variation (uncertainty).

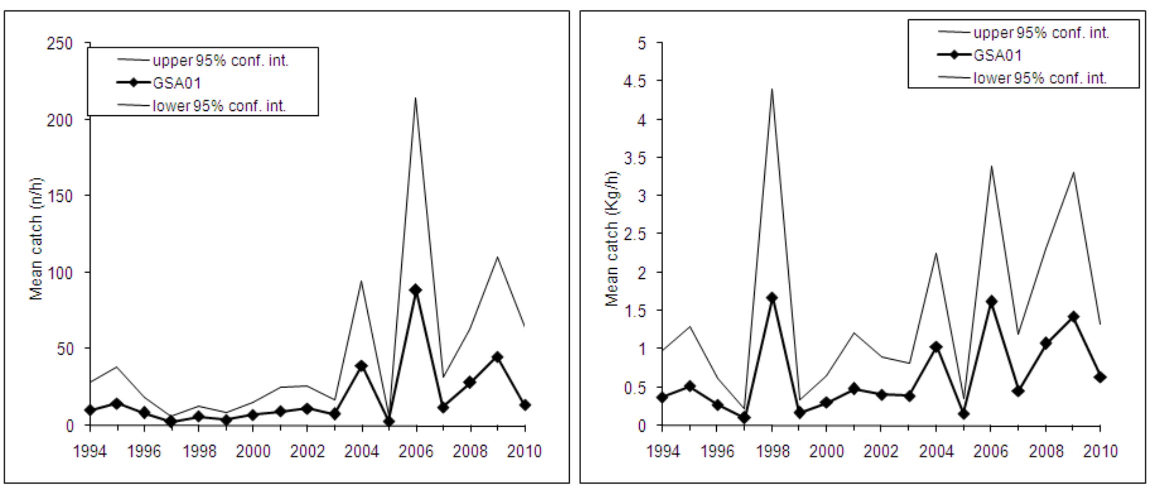


Fig. 6.2.3.1.3.1 Abundance and biomass indices of hake in GSA 01.

6.2.3.1.4 Trends in abundance by length or age

The following Figs. 6.2.3.1.4.1 and 2 display the stratified abundance indices of GSA 01 in 1994-2001 and 2002-2009 and were compiled in the SGMED-10-02 report.

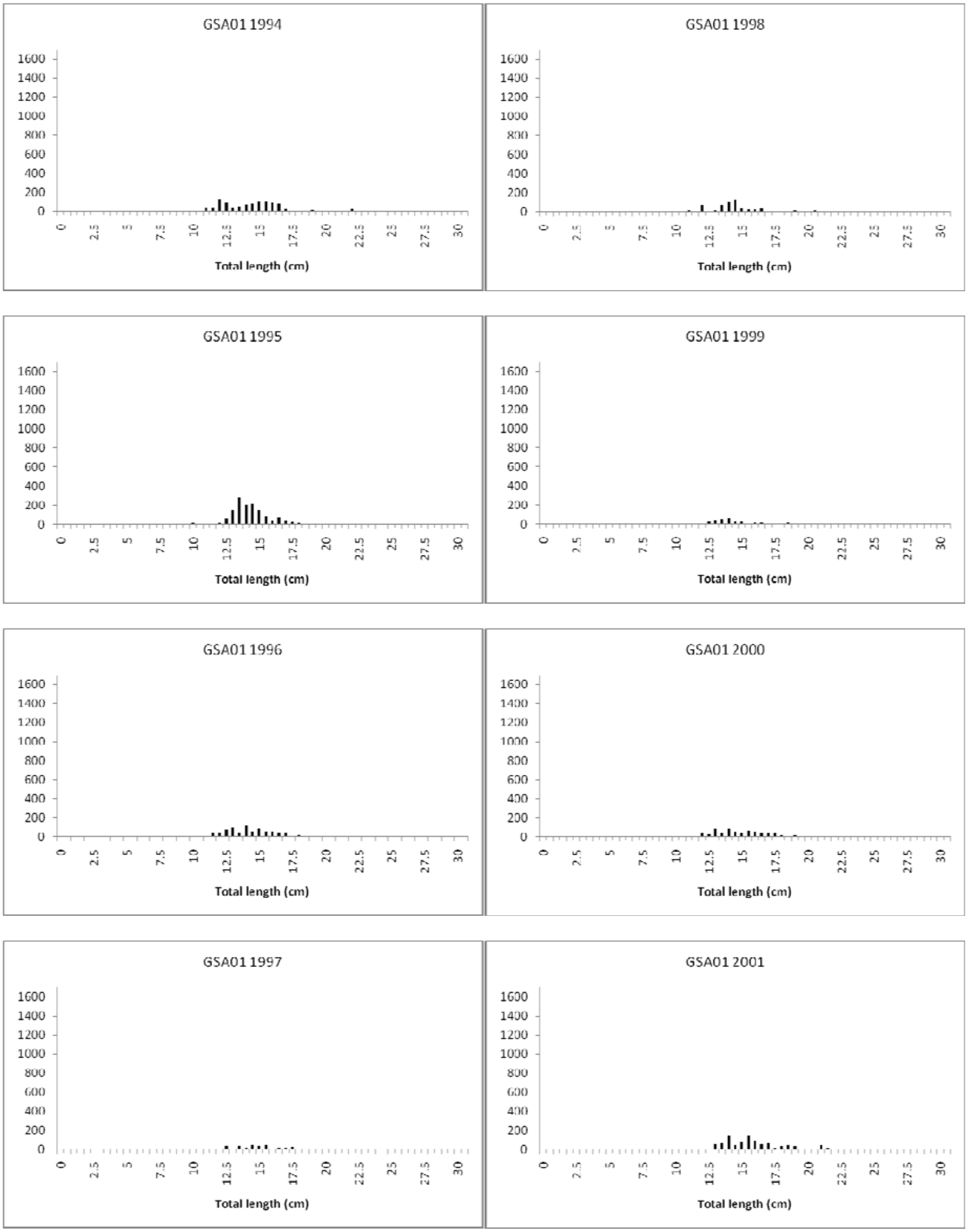


Fig. 6.2.3.1.4.1 Stratified abundance indices by size, 1994-2001.

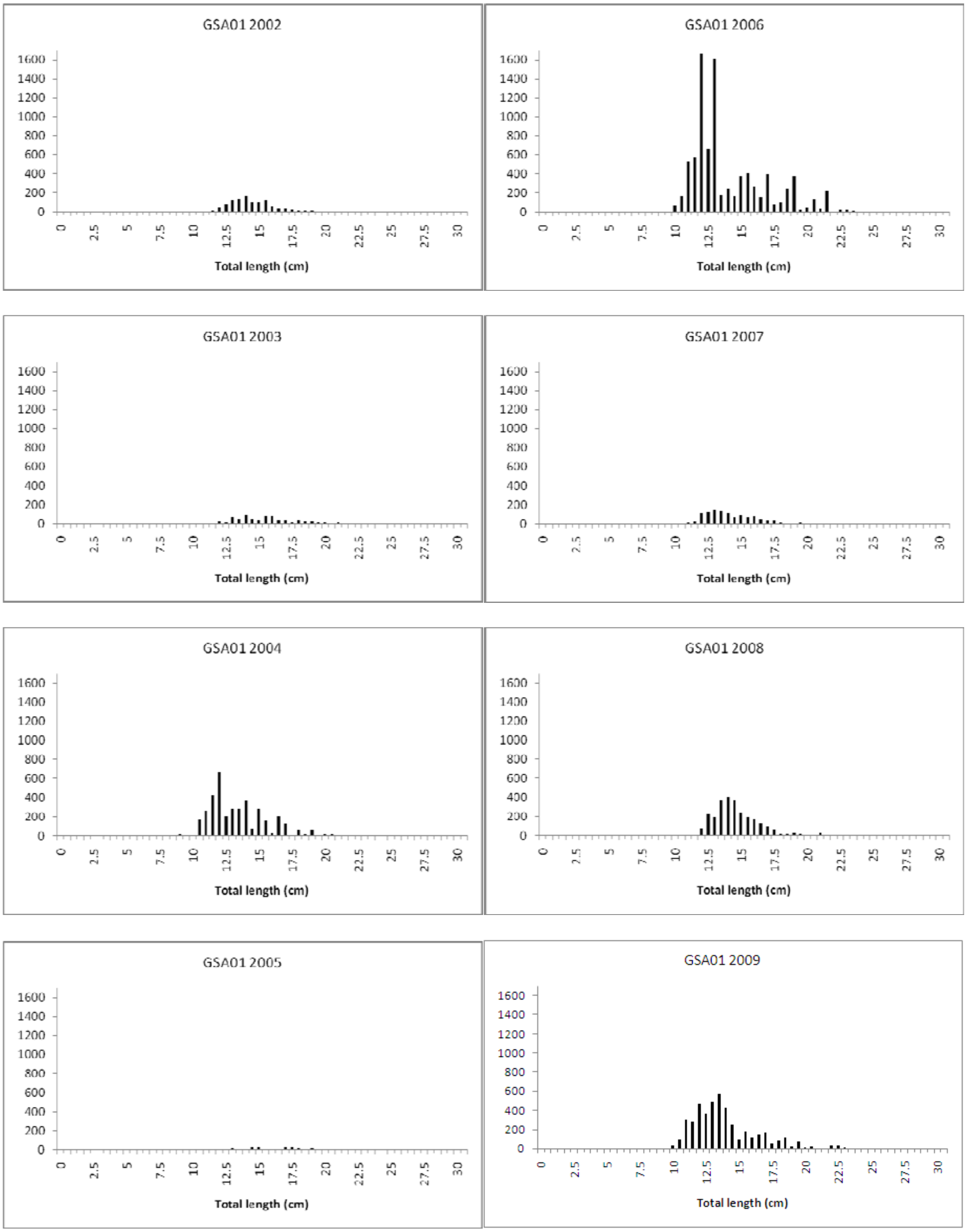


Fig. 6.2.3.1.4.2 Stratified abundance indices by size, 2002-2009.

6.2.3.1.5 Trends in growth

No information was been documented.

6.2.3.1.6 Trends in maturity

No information was been documented.

6.2.4 Assessments of historic stock parameters

6.2.4.1 Method 1: LCA

6.2.4.1.1 Justification

The last assessment of this stock was done in 2008 in the SGMED_0803 report (Cardinale et al., 2008). It was performed a pseudo-cohort analysis using the period (2005-07). Furthermore, a yield per recruit (Y/R) analysis was also performed. For both analyses, the VIT software (Lleonart and Salat 1992) was used.

6.2.4.1.2 Input parameters

During EWG11-05 2008 and 2009 data were assessed separately, through pseudocohort analysis and yield per recruit analysis using VIT software.

The length frequency distributions used for the present assessment showed the same size range with modal differences. In 2008 modal length was11 cm, while in 2009 modal length was 16 cm, similar to modal length reported in the previous assessment (2005-07).

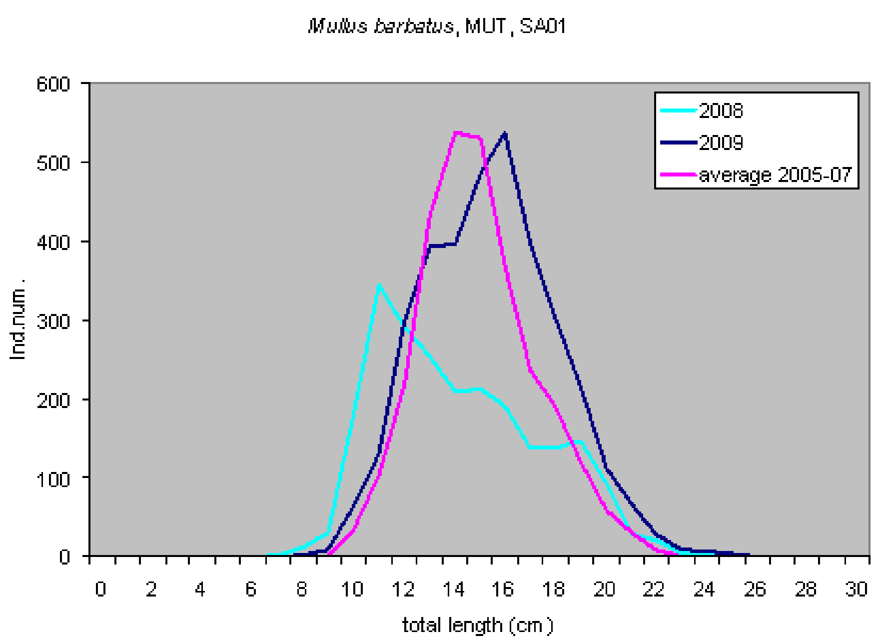


Fig. 6.2.4.1.2.1. Length frequencies for the period 2005-07 (SGMED_0803 assessment), 2008 and 2009.

The biological parameters used were the following:
The set of growth parameters used for last assessment of red mullet in SA06 (SGMED_10-02) has been used: Linf=29.0, K=0.6, t0=-0.1. Length-weight relationships: a=0.0053, b=3.112.

Natural mortality by age was calculated using the PROBIOM spreadsheet (Abella et al. 1997), obtaining the following vector:

Age	0	1	2	3	4+	Mean
M	1.36	0.77	0.66	0.61	0.54	0.79

To calculate the terminal fishing mortality (Ft) from the catch curve, it was considered: Ft=0.995 in 2008 and Ft=0.907 in 2009.
These set of parameters are different than biological parameters used in the previous assessment (2005-07, SGMED_0803): Linf=26, K=0.41, to=-0.4; a=0.0062, b=3.1597, due to the proximity of Linf to the maximum length in catches (25 cm).
The maturity ogive used was the same that was obtained from the Spanish National Data Collection in GSA01 and compiled in SGMED_0803 report.

6.2.4.1.3 Results

Table 6.2.4.1.3.1 shows the summary results from the pseudo-cohort analysis in 2008 and 2009 and in previous assessment (2005-07). These results show that the current level of exploitation is high and there are noticeable differences between 2008 and 2009, especially regarding the mean landing size and recruitment. In any case results on catches show that at the present, catch mean ages and length have decreased compared to 2005-07 analyses, while total catch has moderately increased in 2009. In a general view, results on 2008 are quite different from the other analyses and represent a scenario with catches more centered in juveniles (class 0). Figure 6.2.4.1.3.1 shows the vector of fishing mortality by age resulting from the pseudo-cohort analysis.

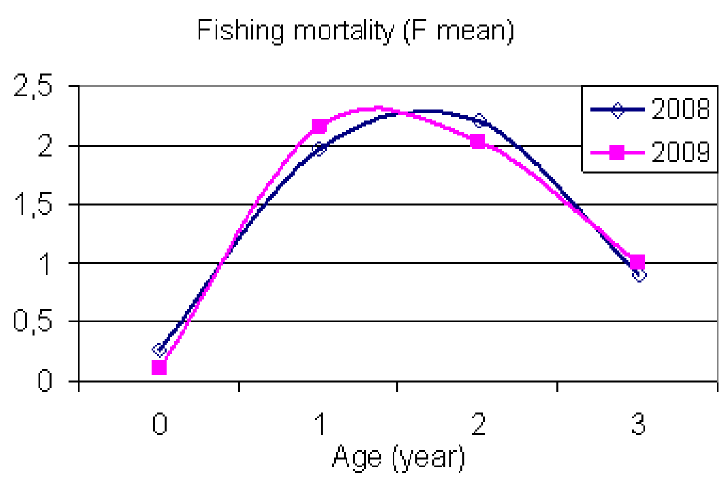


Fig. 6.2.4.1.3.1 Fishing mortality by age from VIT pseudo-cohort analysis.

Tab. 6.2.4.1.3.1 Summary results of stock parameters derived from the VIT model for the period 2005-07, 2008 and 2009.

	2005-07	2008	2009
Catch mean age	1,73	0,88	1,09
Catch mean length	14,75	11,93	14,07
Mean F	1,39	1,33	1,32
Global F	0,29	0,49	0,38
Total catch (tons)	113,61	113,4	154,21
Catch/D%	57,69	55	54,83
Catch/B%	80,28	123,9	123,65
Current Stock Mean Age	0,791	0,50	0,51
Current Stock Critical Age	1	1	1
Virgin Stock Critical Age	4	2	2
Current Stock Mean Length	9,51	8,10	8,25
Current Stock Critical Length	11,36	14,01	14,01
Virgin Stock Critical Length	21,72	20,77	20,77
Number of recruits, R (x10^3)	11626,97	19722,05	24534,01
Mean Biomass, B_{mean} (tons)	141,51	91,50	124,71
Spawning Stock Biomass, SSB (tons)	86,17	57,64	79,58
Biomass Balance, D (tons)	196,92	206,18	281,26
Natural death/D	42,31	45,00	45,17
B_{max}/B_{mean}	48,93	84,54	90,17
Turnover, D/B_{mean}	139,16	225,32	225,52
B_{now}/B_{virgin} (%)	20,7	33,41	21,73

6.2.5 Long term prediction

6.2.5.1 Justification

A Y/R analysis for years 2008 and 2009 was conducted based on results obtained on pseudocohorts analyses with VIT software. These results are compared with the previous ones for the period 2005-07.

6.2.5.2 Input parameters

The length frequency data from 2008 and 2009 and the biological parameters were used as given in table 6.2.5.2.1.

6.2.5.2.1. Input parameters to the yield per recruit analysis, separately for 2008 and 2009.

2008						
age min	age group	stock weight (g)	catch weight (g)	maturity	F	M
0	0	4,047	4,047	0,43321	0,27	1,36
age max	1	33,482	33,482	0,75899	1,96	0,77
3	2	82,465	82,465	0,8828	2,193	0,66
F(2008)	3	127,549	127,549	0,93321	0,907	0,61
1,3						
2009						
age min	age group	stock weight (g)	catch weight (g)	maturity	F	M
0	0	4,251	4,251	0,45869	0,114	1,36
age max	1	32,967	32,967	0,75899	2,145	0,77
3	2	82,911	82,911	0,8828	2,032	0,66
F(2009)	3	127,333	127,333	0,93321	0,995	0,61
1,3						

6.2.5.3 Results

Table 6.2.5.3.1 lists the results from the Y/R analysis, and Fig. 6.2.5.3.1 shows the Y/R when the actual level of exploitation (factor=1) is doubled (factor=2).

The figure indicates signs of light overexploitation in 2008 but not in 2009. In this last year, the Y/R curve is asymptotic and, hence, is not possible to find a clear maximum value for Y/R.

Taking in account previous and present assessments, the status of this stock would be defined as over-exploited.

Tab 1.1.5.3. Results of the Y/R analysis.

Phi		Factor	Y/R	B/R	SSB
Absence of fishing	2005-07	0	0	58,85	51,11
	2008	0	0	23,391	18,976
	2009	0	0	23,391	19,037
F0.1	2005-07	0,26	9,99	28,63	22,24
	2008	0,41	6,254	9,96	7,22
	2009	0,44	6,673	9,813	7,117
Y/Rmax	2005-07	0,46	10,62	20,63	14,84
	2008	0,81	6,801	6,181	4,072
	2009	not defined	not defined	not defined	not defined
Current	2005-07	1	9,77	12,17	7,41
	2008	1	6,756	5,302	3,372
	2009	1	7,516	5,735	3,718
Max factor	2005-07	2	8,59	7,83	3,99
	2008	2	6,16	3,269	1,842
	2009	2	7,533	3,848	2,261

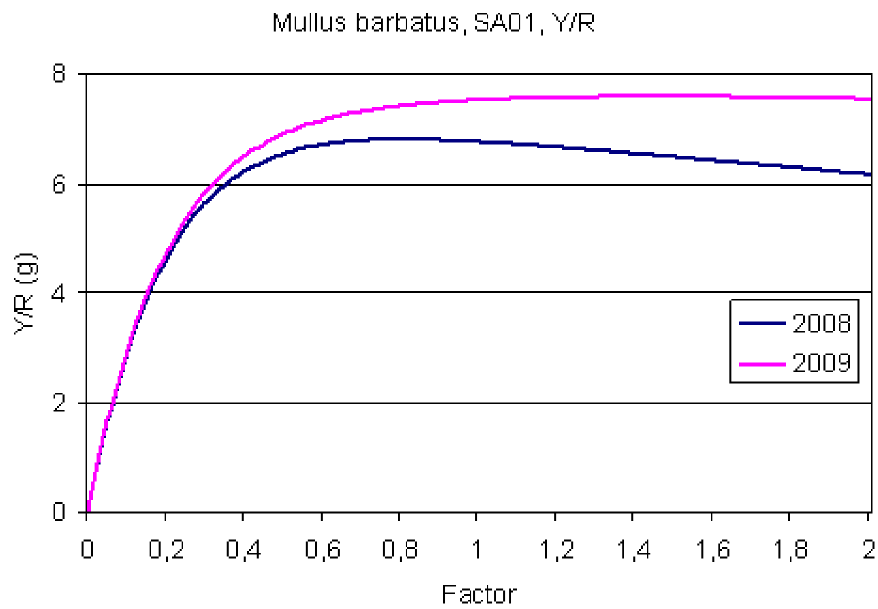


Fig. 6.1.5.3.1.1 YpR analysis for hake in GSA 1.

F is estimated to range in the order of 1.3. $F_{0.1}$ amounts to 0.52.

6.2.6 Data quality

The major shortfall is that fishing effort data have not been provided.

6.2.7 Scientific advice

6.2.7.1 Short term considerations

6.2.7.1.1 State of the stock size

EWG 11-05 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the state of the data and analyses.

6.2.7.1.2 State of recruitment

EWG11-05 is unable to provide any scientific advice of the state of the recruitment given the state of the data and analyses.

6.2.7.1.3 State of exploitation

EWG 11-05 proposed $F_{0.1}$=0.52 as limit reference point consistent with high long term yield (F_{msy} proxy).

Based on the assessment results EWG 11-05 assessed the status of the stock of red mullet in GSA 1 as being subject to overfishing.

6.3 Stock assessment of blue and red shrimp in GSA 01

6.3.1 Stock identification and biological features

6.3.1.1 Stock Identification

No information was documented during EWG-05-11 regarding stock delimitation of blue and red shrimp, *Aristeus antennatus* (Risso, 1816).

6.3.1.2 Growth

No information was documented during EWG-05-11.

6.3.1.3 Maturity

No information was documented during EWG-05-11.

6.3.2 Fisheries

6.3.2.1 General description of fisheries

No information was documented during EWG-05-11.

6.3.2.2 Management regulations applicable in 2010 and 2011

No information was documented during EWG-05-11.

6.3.2.3 Catches

6.3.2.3.1 Landings

The following table 6.3.2.3.1.1 shows the trend in landings as obtained from the DCF data call in 2010. Updated information on landings is presented on annual basis (2002-2009). Throughout the time series landings fluctuated between 150 and 422 t, with an average of c.a. 290 t, with a continuous decreasing trend.

Table 6.3.2.3.1.1 Landings of blue and red shrimp in GSA 01.

AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007	2008	2009
1	ESP	OTB	339.627	422.673	346.253	283.988	371.231	216.781	150.323	184.414

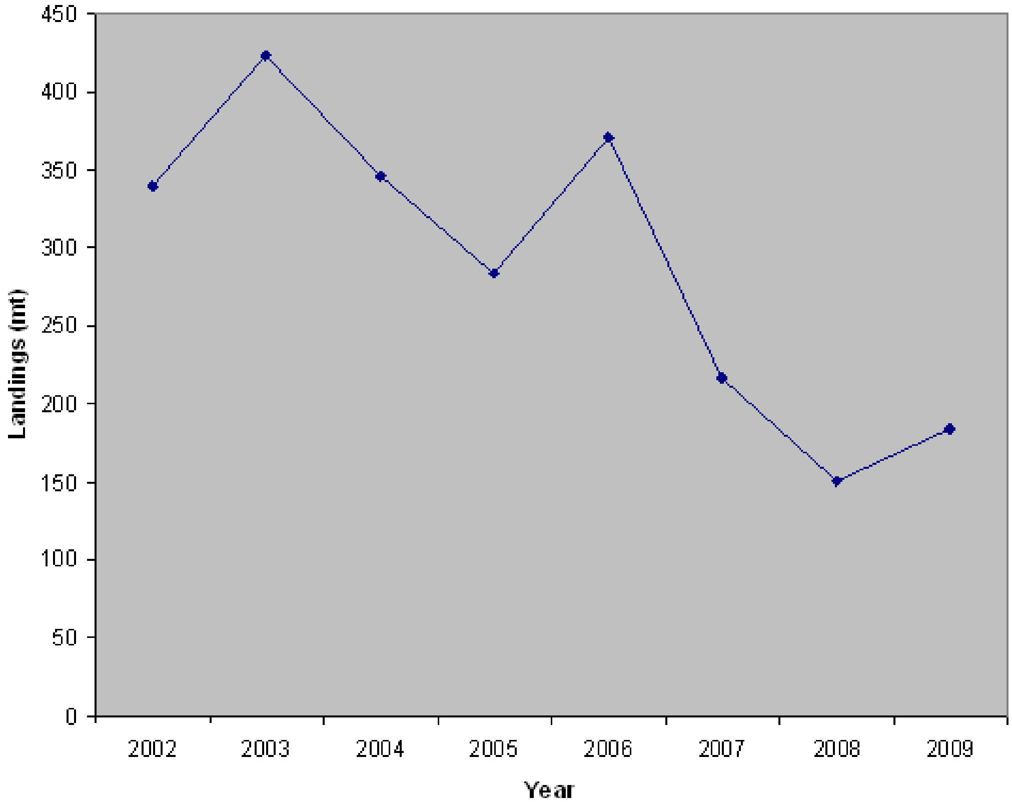


Fig 6.3.2.3.1.1 Landings by Spanish trawlers of blue and red shrimp in GSA 01.

6.3.2.3.2 Discards

No updated information was documented during EWG-05-11. However, this species is known to have no significant discards. Data on discards were provided for the years 2005, 2008 and 2009, ranging from 0.0004 to 0.4 mt at a year for the whole area.

6.3.2.3.3 Fishing effort

No information was documented during EWG-05-11. STECF (stock review part II in 2007) noted that in the GSA 01 there are 140 trawlers, considering shelf and slope activity, and landing around 400 tonnes by year.

6.3.3 Scientific surveys

6.3.3.1 MEDITS

6.3.3.1.1 Methods

Based on the DCR data call, abundance and biomass indices were recalculated. In GSA01 the following number of hauls was reported per depth stratum (Tab. 6.1.3.1.1.1).

Tab. 6.1.3.1.1.1. Number of hauls per year and depth stratum in GSA01, 1994-2010.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GSA01_010-050	2	1	2	2	2	2	2	3	3	3	3	2	3	3	4	2	3
GSA01_050-100	5	4	5	5	5	7	6	4	6	10	7	7	6	6	6	7	6
GSA01_100-200	3	3	3	5	5	5	5	4	8	6	5	6	5	6	6	6	4
GSA01_200-500	7	9	11	10	7	11	12	10	11	11	13	11	11	11	11	11	6
GSA01_500-800	6	9	12	10	12	12	9	13	13	14	13	11	15	10	7	5	6

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Catches by haul were standardized to 60 minutes hauling duration. The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$
$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$
Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean
The variation of the stratified mean is then expressed as the 95 % confidence interval:
Confidence interval = $Yst \pm t$(student distribution) * V(Yst) / n

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA.

6.3.3.1.2 Geographical distribution patterns

No information was documented during EWG-05-11.

6.3.3.1.3 Trends in abundance and biomass

Fishery independent information regarding the state of the blue and red shrimp in GSA01 was derived from the international survey MEDITS. Figure 6.3.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 01. The estimated abundance and biomass indices indicate very low stock sizes since 2007.

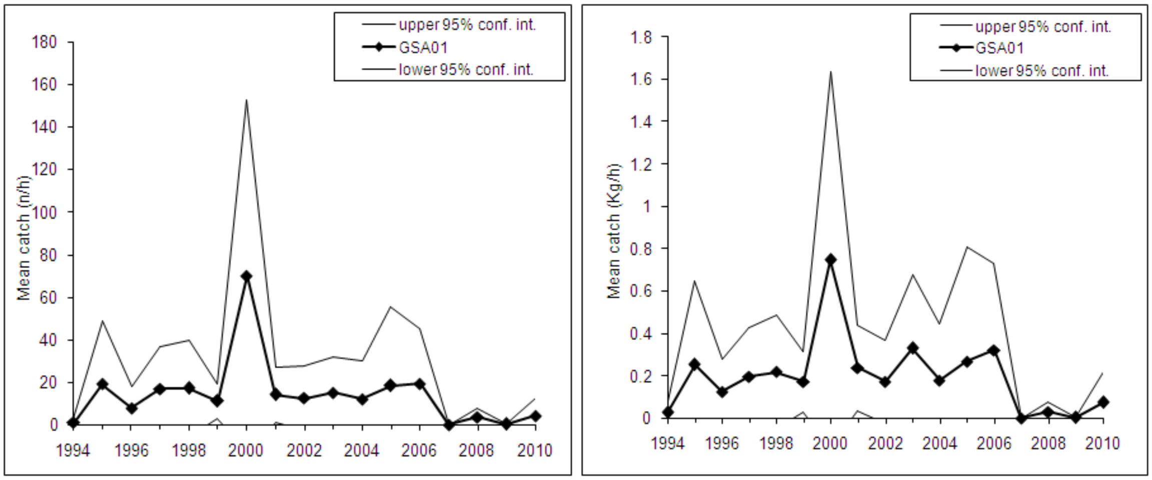


Fig. 6.3.3.1.3.1 Abundance and biomass indices of hake in GSA 01.

6.3.3.1.4 Trends in abundance by length or age

No information was been documented.

6.3.3.1.5 Trends in growth

No information was been documented.

6.3.3.1.6 Trends in maturity

No information was been documented.

6.3.4 Assessments of historic stock parameters

6.3.4.1 Method 1: LCA

6.3.4.1.1 Justification

The pseudo-cohort analysis VIT was applied using data from 2008 and 2009.

6.3.4.1.2 Input parameters

The biological data to condition the VIT analysis are defined as follows:

Growth parameters used were those from Garcia-Rodriguez (2003) over length distribution analysis (Linf= 77.0; K = 0.38; t0= -0.065), and length-weight relationship (a= 0.0024; b= 2.467).

Maturity ogive was taken from García Rodriguez (2003), with size at first maturity (50 %) at 23.5 mm CL.

Age class	0	1	2	3	4	5
Maturity ratio	0.1620669	0.6820046	0.986669	0.9990974	1	1

The length frequencies on the period 2005 to 2009, show a first modal value between 24 and 28 mm, with a decreasing trend of this modal value along the series from 5500000 individuals on 2005 and 2006 until 1500000 individuals for 2009.

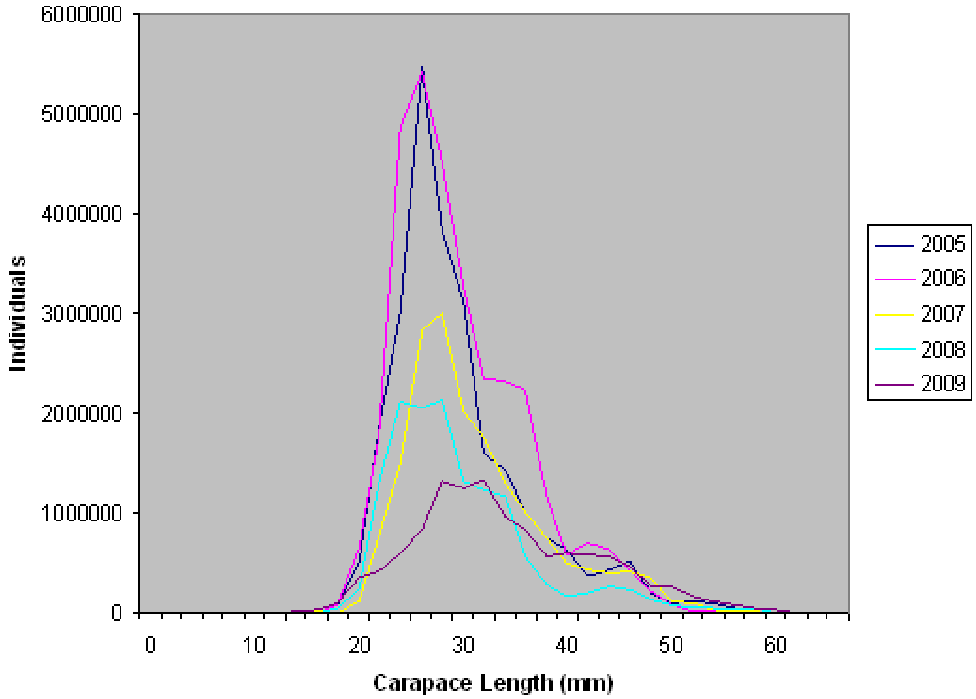


Figure 6.1.4.3.2.1. Landing sizes of hake in GSA 01 during 2005-2009.

6.3.4.1.3 Results

Total stock biomass represented ranges at 203 t. SSB are 117 tonnes, and the average catch is 241 tonnes. Recruits (aged 0 individuals) were estimated to have a constant (steady state) value ($27*10^6$).

Recruits (aged 0 individuals) were estimated to have a value of 4.6 and 10.8 ind.*10^6 in 2008 and 2009.

Fishing mortality acts especially over ages 1-3, declining thereafter. Average fishing mortality of all ages is estimated to range at 0.96-1.19 (Fig. 6.3.4.3.1.1).

The estimated F value (average of all ages) amounts to 1.32.

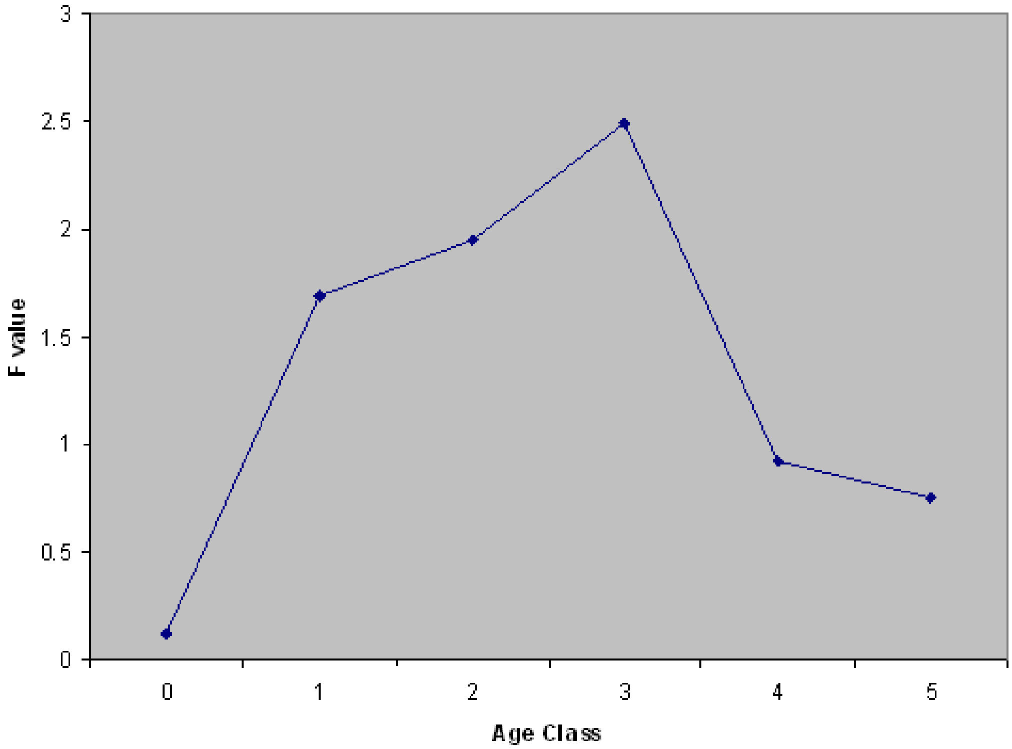


Fig. 6.3.4.3.1.1 Fishing mortality over ages.

6.3.5 Long term prediction

6.3.5.1 Justification

The yield per recruit from the VIT was applied.

6.3.5.2 Input parameters

The length frequency data from 2008 and 2009 and the biological parameters were used as given in table 6.3.5.2.1

Table 6.3.5.2.1. Input parameters to the yield per recruit analysis.

age group	stock weight	catch weight	maturity	F	M
0	0.002	0.002	0.1620669	0.1240	0.45
1	0.014	0.014	0.6820046	1.6870	0.45
2	0.033	0.033	0.986669	1.9510	0.45
3	0.053	0.053	0.9990974	2.4870	0.45
4	0.073	0.073	1	0.9250	0.45
5	0.087	0.087	1	0.7500	0.45

6.3.5.3 Results

Max. Y/R value is of 0.008 kg. $F_{0.1}$ was established at 0.29 while F_{max} was 0.52.

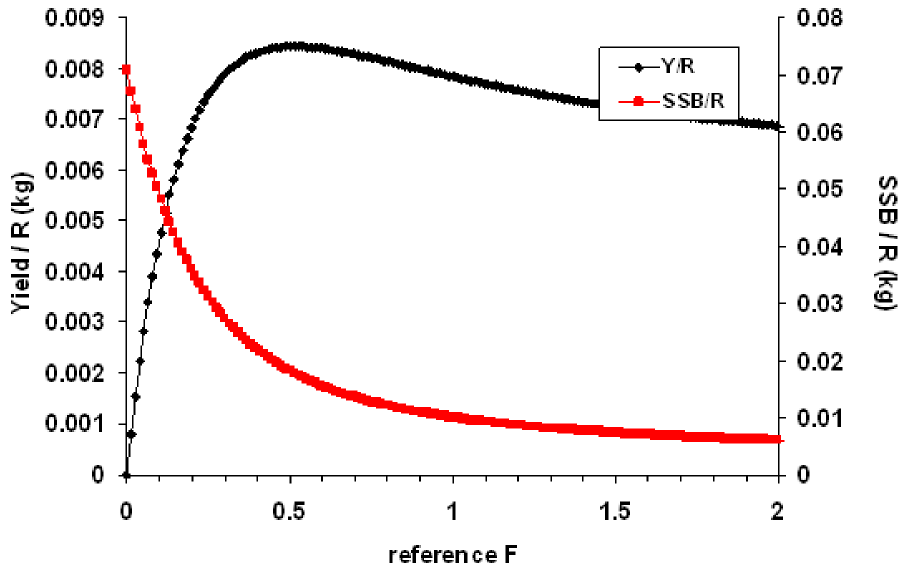


Fig. 6.3.5.3.1.1 YpR analysis for hake in GSA 1.

6.3.6 Data quality

The major shortfall is that fishing effort data have not been provided.

6.3.7 Scientific advice

6.3.7.1 Short term considerations

6.3.7.1.1 State of the stock size

Stock assessment has been computed by Length Cohort Analysis (VIT software). MEDITS survey indices indicate a very low stock abundance since 2007. Since no precautionary level for the stock of blue and red shrimp in GSA 01 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

6.3.7.1.2 State of recruitment

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment.

6.3.7.1.3 State of exploitation

EWG 11-05 proposes $F_{0.1} \leq 0.29$ as limit management reference point consistent with high long term yields (F_{MSY} proxy).

As the fishing mortality is estimated at 1.32 in the year 2009, and in excess of $F_{0.1}$, the stock does not appear to be able to sustain the current level of fishing effort in the GSA01 and thus EWG 11-05 classifies the stock being subject to overfishing.

6.4 Stock assessment of poor cod in GSA 09

6.4.1 Stock identification and biological features

6.4.1.1 Stock Identification

The poor cod (*Trisopterus minutus capelanus*), a subspecies of the Atlantic species *Trisopterus minutus* (Linnaeus, 1758) is one of the most common gadids, found in small schools on muddy and sandy bottoms from 20 m to over 250 m depth, with greater abundances between the depths of 40 and 120 m. Studies carried out in the northern Tyrrhenian Sea have shown a significant correlation between decreasing average size of the population and increasing depth (Biagi et al., 1996).

A genetic analysis using allozyme and minisatellite loci showed a clear separation between individuals distributed Gulf of Lions and in the Tuscany Archipelago (Mattiangeli*et al*., 2003).

6.4.1.2 Growth

The maximum size reached by the species is 28 cm TL, but more commonly specimens between 10 and 20 cm TL are found.

The following parameters of Von Bertalanffy's growth have been estimated using length frequency distribution analysis for both sexes combined:

L_∞ = 27.0 cm, K=0.45, t_o=0

The poor cod carries out its predatory activity near the bottom and displays a diet composed of benthic organisms and to a certain degree of nektobenthic species. Studies on the feeding behaviour of the Tyrrhenian stock(Sartor, 1993; Colloca, 2010) confirm that the diet is composed prevalently of mysid crustaceans, benthic decapods and Gobidae; other taxa have a secondary importance. Mysidacea, with *Lophogastertypicus*, constitute the main prey for specimens with TL<10 cm; decapods, present in a large number of species, most importantly *Alpheus glaber* and *Chlorotocuscrassicornis*, are a very important food items for specimens larger than 10 cmTL.

6.4.1.3 Maturity

The rather long reproductive period (some 4-5 months) runs from the end of winter to late summer, probably with more than one spawning in the course of the reproductive season. Spawners tend to concentrate between the depths of 50 and 120 m. In the northern Tyrrhenian Sea the prevalence of large females has been observed at the start of the reproductive season, followed by the progressive maturation of smaller specimens. The size of first sexual maturity range for the two sexes combined range between 10.5 and 15 cm TL during the Medits survey (Fig. 6.4.1.3.1).

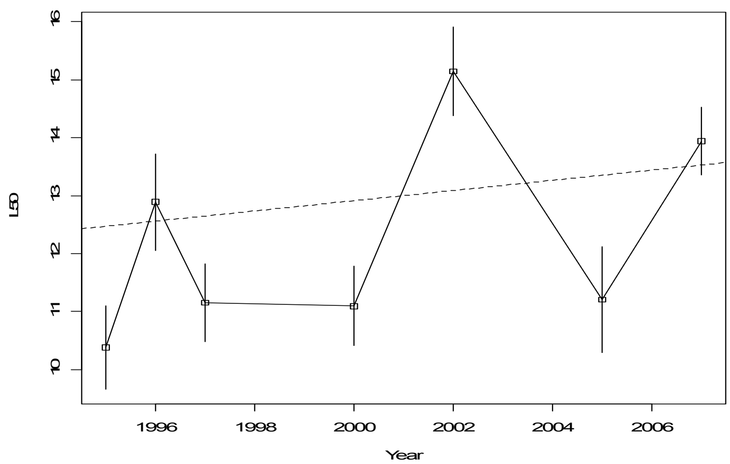


Fig 6.4.1.3.1 Length of first maturity (L_{50}) of poor cod in GSA 9 during MEDITS (1995-2007).

Recruits occurr from late spring to early summer mainly concentrating at depths between 100 and 200 m.

6.4.2 Fisheries

6.4.2.1 General description of fisheries

Poor cod is a by-catch demersal species in the GSA 0 9, usually landed mixed with other small-sized species (*frittura*). Almost all the landings of poor cod are due to bottom trawl vessels; the remaining fraction is caught by artisanal vessels using set nets, in particular trammel nets. Poor cod is one of the species exploited by the demersal trawl fishery targeting a highly diversified species assemblage, including hake, red mullet and horned octopus (*Eledonecirrhosa*) on deep shelf. The trawl fleet of GSA 09 at the end of 2009 accounted for 360 vessels. The main trawl fleets of GSA 09 are present in the following continental harbours: Viareggio, Livorno, Porto Santo Stefano (Tuscany), Fiumicino, Terracina, Gaeta (Latium). The fishing capacity of the GSA 09 has shown in these last 20 years a progressive decrease; from 1996 to 2006 the number of bottom trawlers of GSA9 decreased of about 30%. Consequently also fishing effort decreased, even though in a lesser extent, in this period. In the last five years the total landings of poor cod of GSA 09 fluctuated between 226 (2004) and 93 tons (2007). In 2009 the landing was 120 tons.

Tab. 6.4.2.1.1 Technical characteristics of the trawl fleet of GSA 09.

N. of boats	361
GT	13.191
kW	75.514
Mean GT	36.5
Mean kW	209.2

As concerns fishing activity, the majority of bottom trawlers of GSA 09 operate daily fishing trips with only some vessels staying out for two-three days and especially in summer.

6.4.2.2 Management regulations applicable in 2010 and 2011

- Fishing closure for trawling: 45 days in late summer (not every year have been enforced)
- Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets will be replaced with a cod end with 40 mm square meshes or a cod end with 50 mm (stretched) diamond meshes.
- Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast.
- Two small No Take Zones ("Zone di TutelaBiologica", ZTB) are present inside the GSA 09; one off the Giglio Island (50 km^2, northern Tyrrhenian Sea) another off Gaeta, (125 km^2, central Tyrrhenian Sea). Bottom fishing was not allowed in the two ZTB. A recent regulation of the Italian Ministry of Agricultural, Food and Forestry Policies has established that fishing activity can be carried out in these two areas from July 1st to December 31st.

6.4.2.3 Catches

6.4.2.3.1 Landings

In the last six years the total landings of poor cod in the GSA 09 fluctuated between 90 to about 230 tons (Fig. 6.4.2.3.1.1).

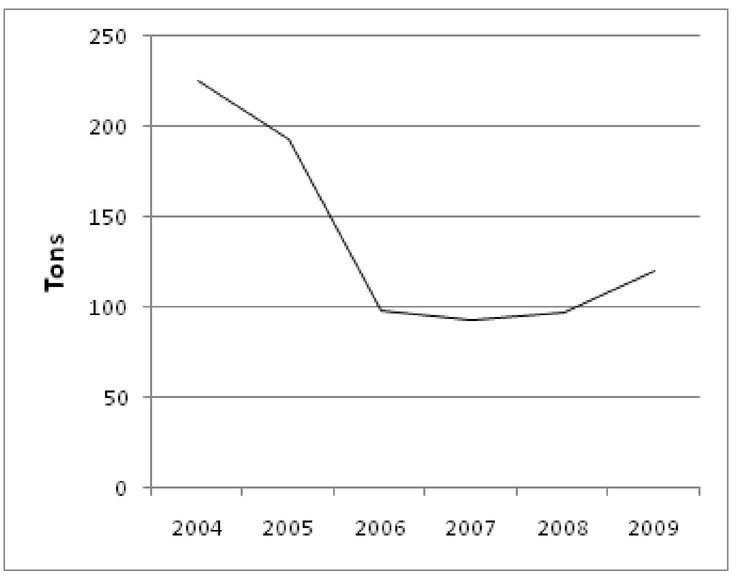


Fig. 6.4.2.3.1.1 Landings of poor cod in the GSA 09, from 2004 to 2009 (DCF official data).

Table 6.4.2.3.1.1 Landings (t) by year and major gear types, 2004-2009 as reported through DCF.

Gear	2004	2005	2006	2007	2008	2009
GNS		3.26		4.20	0.52	0.45
GTR				0.59	0.42	0.04
OTB	225.81	189.72	98.76	88.29	96.00	119.98

Total	225.81	192.98	98.76	93.09	96.95	120.48

6.4.2.3.2 Discards

Poor cod juveniles are completely discarded at sea do not having commercial value. There are no quantitative data available.

6.4.2.3.3 Fishing effort

The fishing capacity of the GSA 09 has shown in these last 10 years a progressive decrease; from 1996 to 2009. Fishing effort (kw*fishing days) performed by the GSA 09 trawlers decreased from about 14,000,000 in 2004 to about 12,000,000 in 2009; that of set nets (GNS and GTR) remained substantially stable in the period considered (Fig. 6.4.2.3.3.1).

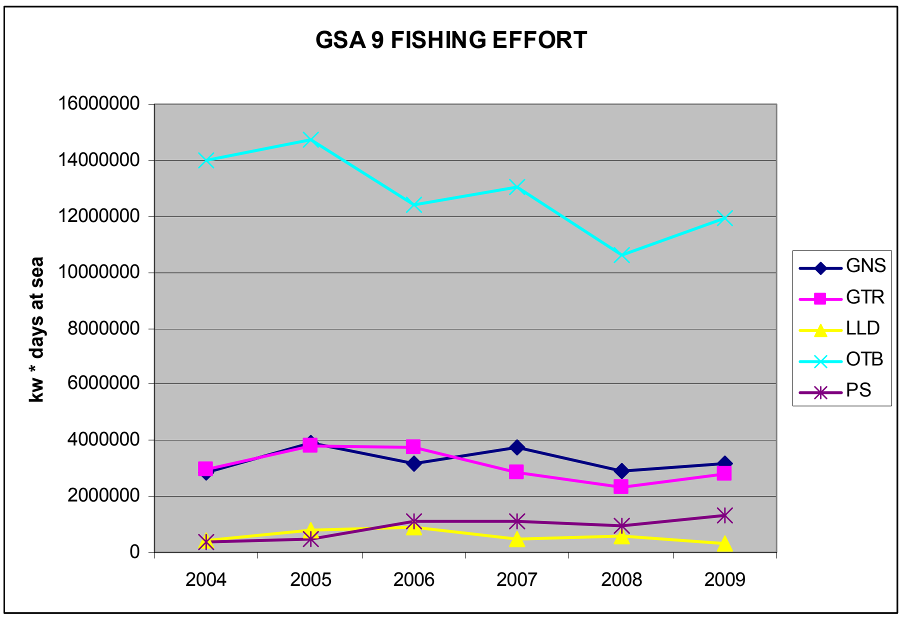


Fig. 6.4.2.3.3.1 Effort trends (days and kW*days) by major fleets, 2004-2009.

6.4.2.3.3.1 Trends in annual effort (kW*days) by trammel nets (GTR), gillnets(GNS) and bottom trawlers (OTB) deployed in GSA 09, 2004-2009.

Gear	2004	2005	2006	2007	2008	2009
GNS	2828257	3887852	3192557	3730816	2897517	3165163
GTR	2930802	3825650	3758552	2840462	2330668	2819133
OTB	13997398	14737375	12427695	13044590	10602617	11927325
Totalecomplessivo	22497157	26025726	22959178	22209228	18280340	20473124

6.4.3 Scientific surveys

6.4.3.1 MEDITS

6.4.3.1.1 Methods

Based on the DCF data call, abundance and biomass indices were recalculated. In GSA 09 the following number of hauls were reported per depth stratum (s. Tab. 6.4.3.1.1.1).

Tab. 6.4.3.1.1.1. Number of hauls per year and depth stratum in GSA 09, 1994-2009.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GSA09_010-050	19	18	18	18	19	18	18	18	13	13	13	14	13	13	13	14
GSA09_050-100	19	20	18	19	18	19	20	20	15	15	15	14	16	16	13	14
GSA09_100-200	35	35	36	35	35	35	34	34	26	27	26	27	25	26	28	27
GSA09_200-500	32	33	33	36	32	36	37	35	27	27	27	28	29	33	30	28
GSA09_500-800	31	30	31	28	30	28	27	29	24	22	21	20	20	17	18	20

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 1 Km^2. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

- A=total survey area
- Ai=area of the i-th stratum
- si=standard deviation of the i-th stratum
- ni=number of valid hauls of the i-th stratum
- n=number of hauls in the GSA
- Yi=mean of the i-th stratum
- Yst=stratified mean abundance
- V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

6.4.3.1.2 Geographical distribution patterns

No information was documented during EWG-05-11.

6.4.3.1.3 Trends in abundance and biomass

Figure 6.4.3.1.3.1 shows the MEDITS abundance index of poor cod obtained from 1994 to 2009; no evident trends are present.

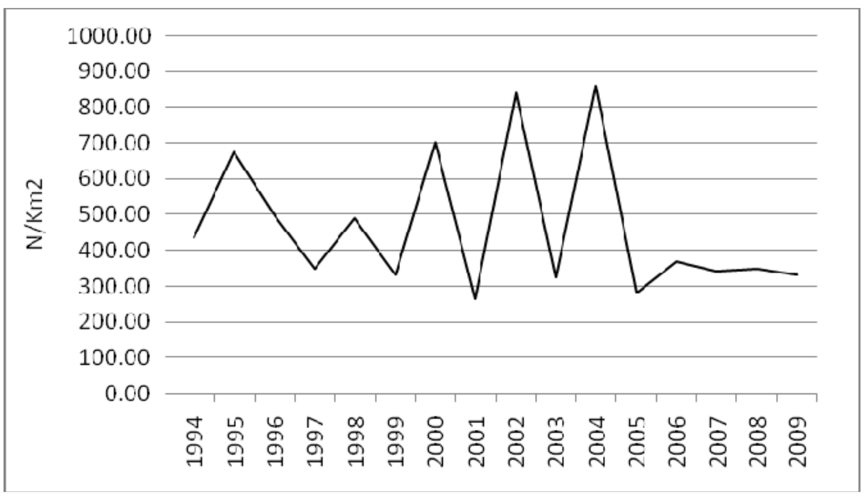


Fig. 6.4.3.1.3.1 Density and biomass MEDITS indices of poor cod in GSA 9.

6.4.3.1.4 Trends in abundance by length or age

The following Fig. 6.4.3.1.4.1 displays the stratified abundance indices of GSA 09 in 1994-2009.

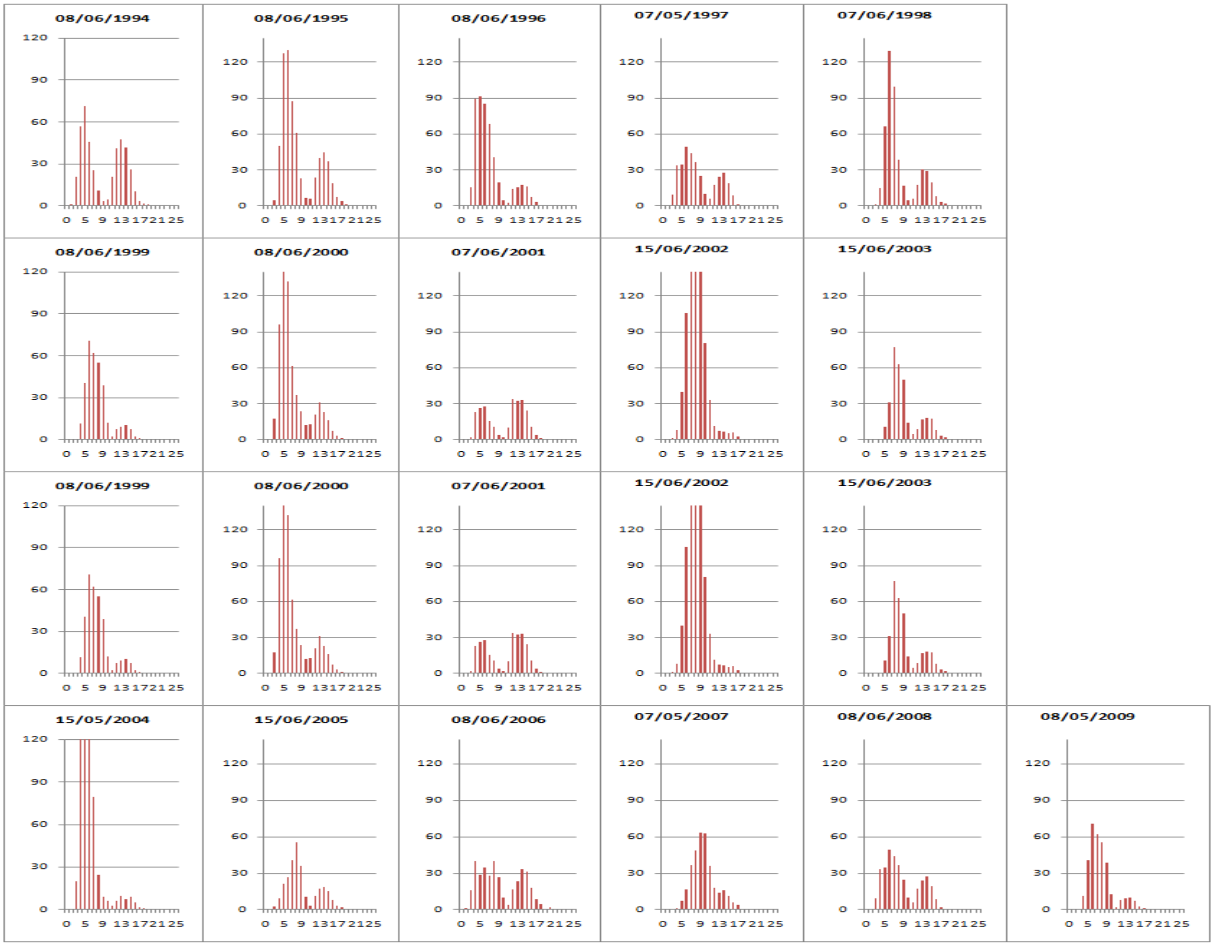


Fig. 6.4.3.1.4.1 Stratified abundance indices by size (n km^{-2}), 1994-2009.

6.4.3.1.5 Trends in growth

No information was been documented.

6.4.3.1.6 Trends in maturity

No information was been documented.

6.4.4 Assessments of historic stock parameters

6.4.4.1 Method 1: SURBA

6.4.4.1.1 Justification

The relatively long time series of data available from the MEDITS surveys provided the most useful data sets for analysis. The survey-based stock assessment approach SURBA (Needle, 2003) was used on MEDITS (1994-2009) data of poor cod in the GSA 09.

6.4.4.1.2 Input parameters

The following set of parameters was adopted:

Growth parameters (Von Bertalanffy)
L∞ = 27 (cm, length)
K = 0.45
$t_0 = 0$
L*W
a = 0.00498;
b=3.257
Natural mortality
M vector Age 0 = 1.05, Age 1 = 0.38, Age 2 = 0.28, Age 3 = 0.16
Length at maturity (L50)
L50 = 13 cm
Length of first capture (Lc)
Lc = 10 cm

6.4.4.1.3 Results

Fitted year effect, that is the model proxy for the combination of fishing effort and mean natural mortality in the underlying population, shows fluctuations that are particular wide in the last years. Fitted age effect shows an increasing from age 0 to age 3+, while fitted cohort effect shows a decreasing trend (Figure 6.4.4.1.3.1).

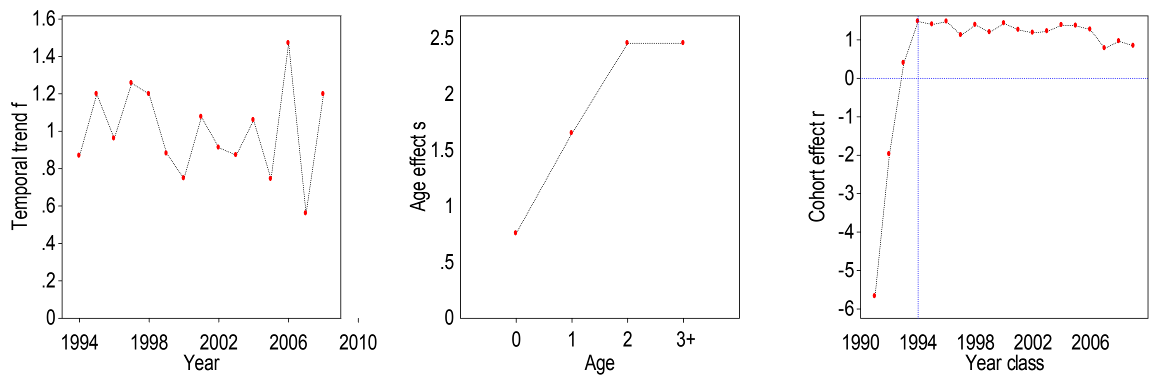


Fig. 6.4.4.1.3.1 MEDITS survey. Fitted year, age and cohort effects estimated by SURBA.

$F_{0\text{-}3+}$estimated from MEDITS indices showed a decreasing between 1994 and 2005 followed by large fluctuations in the last 3 years when it ranged between 1.2 (2007) and 2.21 (2006). In 2008 the estimated $F_{0\text{-}3+}$ was 1.96. Relative SSB was higher during 1994-95, fluctuating without any trend in the last 10 years. Recruitment index showed high variability from year to year without a temporal pattern during MEDITS. The largest year classes were observed in 2005 (Fig. 6.4.4.1.3.2).

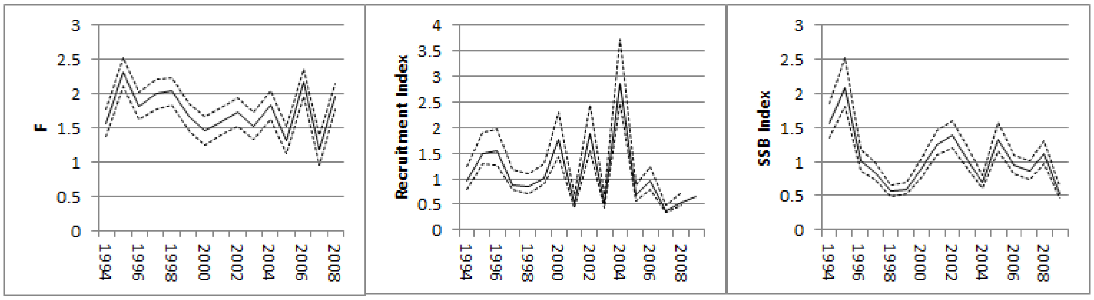
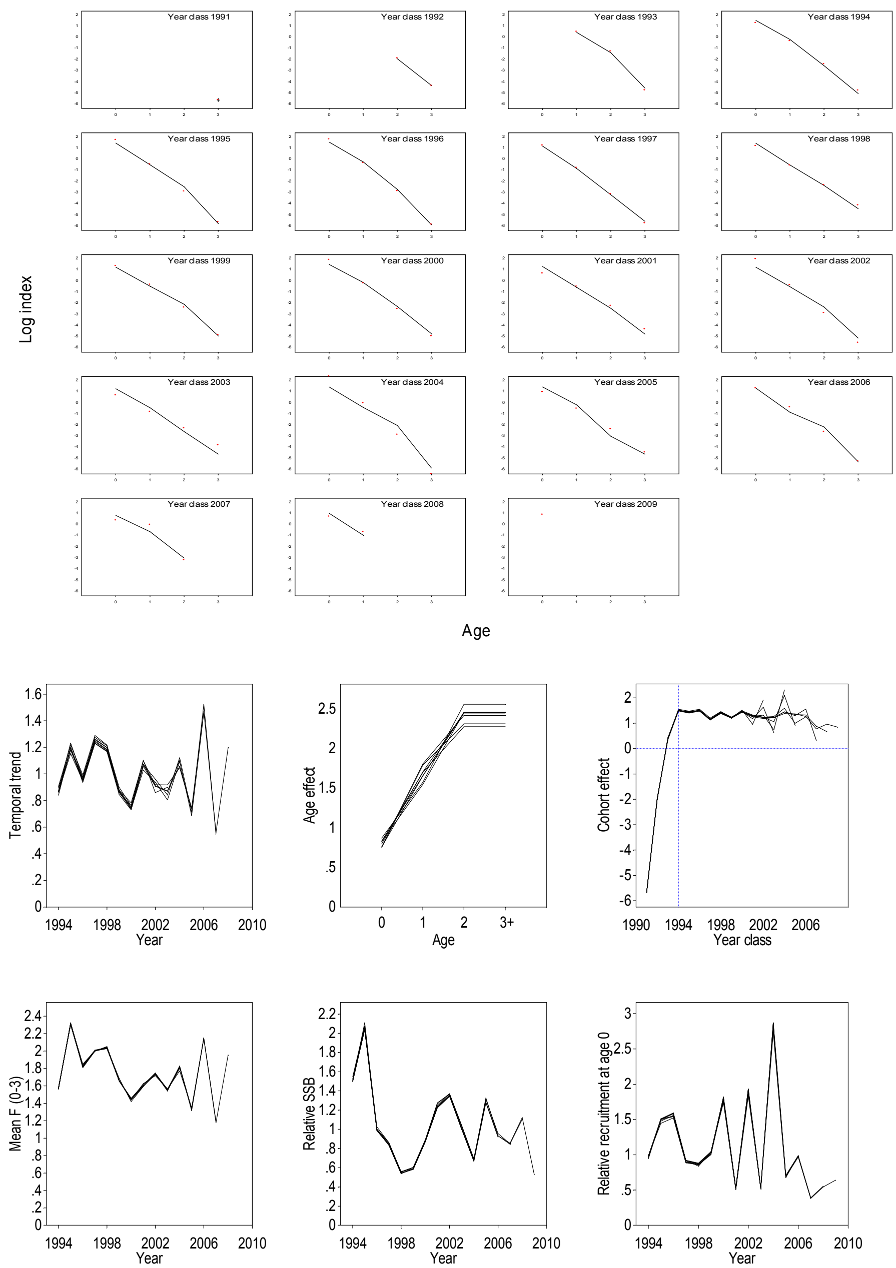


Fig. 6.4.4.1.3.2 MEDITS survey. Estimated trend in F, relative SSB and recruitment using SURBA. 50th percentile of bootstrapped runs (solid line) and 5% and 95% percentiles of bootsrapped runs (dashed lines).

Model diagnostics are shown in the following Fig. 6.4.4.1.3.1.



B)

Fig. 6.4.4.1.3.3 Model diagnostic for poor cod SURBA model in the GSA 09 (MEDITS data). A) Comparison between observed (points) and fitted (lines) survey abundance indices, for each year. B) Results of transition analysis.

6.4.5 Long term prediction

6.4.5.1 Justification

Equilibrium YPR reference points for the stock estimated through the YPR2.2.7 software of NOAA which allow to simulate gradual recruitment of an age-group to the fishery rather than knife-edge recruitmentin which the entire age-group becomesvulnerable to capture at a given time. Partial recruitmentat age was based on selection ogives reflecting the principal gear used in the GSA 9 trawl fishery. In addition the software allows to use an M vector, instead a constant M value as well as weight at age and information from maturity ogive.

6.4.5.2 Input parameters

Input data to calculate equilibrium YPR reference points for the stock are listed in the following Table 6.4.5.2.1.

Table 6.4.5.2.1. Input parameters to the YpR analysis.

AGE	Selectivity on Fishing Mortality	Selectivity on Natural Mortality	Stock Weights	Catch Weights	Spawning Stock Weights	Fraction Mature
1	0.5000	1.0000	2.6000	2.6000	0.0000	0.0000
2	1.0000	0.3800	27.0000	27.0000	27.0000	1.0000
3	1.0000	0.2800	75.6000	75.6000	75.6000	1.0000
4	1.0000	0.1600	95.0000	95.0000	95.0000	1.0000
5	1.0000	0.1000	144.0000	144.0000	144.0000	1.0000

6.4.5.3 Results

$F_{0.1}$ was esteimated as reference point (Fig. 6.4.5.3.1). The following values were obtained: F_{max} = 0.46; $F_{0.1}$= 0.33 and F_{ref} = 0.37. RPs suggest an overfishing situation for the stock considering current F about six times higher than the limit and target RPs F.

Fig. 6.4.5.3.1. Yield per recruit and SSB per recruit analyses of poor cod he GSA 09 obtained using the YPR software (age groups 1-4).

6.4.6 Data quality

MEDITS survey data were available from 1994. A check of hauls' allocation between GSA 09 and 10 needs to be done before calculation of indices from MEDITS database.

6.4.7 Scientific advice

6.4.7.1 Short term considerations

6.4.7.1.1 State of the stock size

Medits survey indices show a variable pattern of abundance without a clear trend. Since no precautionary level for the stock of poor cod in GSA 09 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

6.4.7.1.2 State of recruitment

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment.

6.4.7.1.3 State of exploitation

Given that the stock assessment is based on survey data only, EWG 11-05 is unable to propose limit management reference points consistent with high long term yield.
In the absence management reference point EWG 11-05 is unable to fully evaluate the exploitation status of the stock.

6.5 Stock assessment of the blue and red shrimp in GSA 09

6.5.1 Stock identification and biological features

6.5.1.1 Stock Identification

Due to a lack of enough information about the structure of blue and red shrimp in the western Mediterranean, this stock was assumed to be confined within the GSA 09 boundaries.

In the GSA09 the blue and red shrimp, *Aristeus antennatus* (Risso, 1816) represent one of the most valuable demersal resources for the trawling fleet operating on the muddy bottoms of the upper and middle slope from 400 to 800 m, where the stock is composed mainly of aggregations of large female spawners (Orsi Relini and Relini, 1979).

The highest abundances have been found in the northern part of the GSA (Ligurian Sea).

The first year of life is scarcely known especially the planktonic phases because the records of larvae are extremely scarce (Heldt, 1955, Seridj, 1971). The smallest individuals collected during the Medits surveys are considered young of the year – 1 year old, because reproduction occurs in a period of six months, from May to October: they are present in low numbers on the Ligurian fishing grounds, but are sometimes very abundant in South Sardinia. In spite of all that, in the past (summer 1987), not only the Gulf of Genoa but the entire Ligurian Riviera up to the borderline with France (red shrimps fishing grounds of the Roja canyon) saw the sudden appearance of a large quantity of small shrimps. These were called "the 1987 recruits" or " 1987 cohorts": *de facto* during summer 1987 commercial fishery showed an aggregation of female spawners covering the size range 20-68mm carapace length (CL), with a very new dominant size at about 38mm CL (Orsi Relini *et al*, submitted). Furthermore analysis of Medits length frequency distributions and length at age of the commercial landings showed that between 2008 and 2009 another recruitment event took place in the area.

6.5.1.2 Growth

The growth of *A. antennatus* has been studied both in the southern part than in the northern part of the GSA09 using model progression analysis (Colloca *et al*., 1998, Orsi Relini and Relini, 1998). Data on recruitment from the Ligurian Sea (Orsi Relini and Relini, 1998) and results of tagging studies (Relini M. *et al*., 2000, 2004) provided the basis for an interpretation of growth in which the possible life span of *A. antennatus* was of 8-10 years. The following sets of Von Bertalanffy growth parameters were estimated: Females: $L\infty = 76.99$, $K=0.21$, $t0=-0.019$ (Orsi Relini and Relini, 1998). More recently this interpretation of growth has been confirmed (Orsi Relini *et al*, submitted, Orsi Relini and Mannini, in press).

A. antennatus, as observed by Brian (1931) and Lagardere (1972), has euryphagous feeding behaviour. Its diet includes both organisms captured on the seabed, such as polychaetes, echinoderms, the decapod *Calocaris macandreae,* small bivalves, gasteropods and crustaceans belonging to various groups, as well as eurybate organisms of the micro-nekton, particularly euphasiaceans and decapods (Relini and Orsi Relini, 1987). If the total number of prey is considered, 50% of the diet of *A. antennatus* appears to be composed of crustaceans (Cartes and Sardà, 1989). However, if one considers not only the number but also the size of prey, pelagic decapods such as the *Sergestidae, Pasiphaeidae* and *Oplophoridae* would assume a role of primary importance (Orsi Relini *et al.*, 1995).

6.5.1.3 Maturity

The reproduction period, although with some differences between the various geographic areas of the Mediterranean, is somewhat extended, starting in spring (April), peaking in summer (July-August), when most of the females reach sexual maturity, and ending in autumn (October-November) (Orsi Relini and Relini, 1979; Orsi Relini and Pestarino, 1981; Colloca *et al.*, 1998).

Four stages of maturing of the ovaries were described by using a macroscopic colorimetric scale (Orsi Relini and Relini, 1979; Orsi Relini and Pestarino, 1981). The immature females or those in the post-emission phase have colourless or white ovaries (stage 1). As the stages of vitellogenesis progress and the carotenoproteins are included, the ovaries are first pink-coloured (stage 2) and then lilac coloured (stage 3, the advanced maturity phase, with oocytes of up to 250 μ). At maximum maturity development the gonad takes on a dark purple colour (stage 4, diameter of the oocytes around 300 μ).

In males the reproduction phase appears longer, and mature males were in fact observed with the hemispermatophores in the end portion of the sperm ducts in autumn and winter (Orsi Relini and Pestarino, 1981).

In the Ligurian Sea, the smallest observed mature female measured 31 mm in carapace length (CL) and the smallest mature male 20 mm (CL) (Orsi Relini and Relini, 1979).

In the Northern and Central Tyrrhenian, the smallest observed mature females measured, respectively, 32 mm and 24 mm. (Righini and Abella, 1994; Colloca *et al.*, 1998).

It is well known that fecundity is a power function of length, in fact the ovary forms a volume in the female body. In large crustacean decapods such as lobsters the reproductive potential of the stock largely depends on the biggest females. In the Penaeidea high fecundities are enhanced by the production of pelagic eggs. Details of fecundity in *A. antennatus* in the present area are available (Orsi Relini and Semeria, 1983) and are summarized in the relationship:

Number of eggs = $0.0046\ CL^{2.904}$

6.5.2 Fisheries

6.5.2.1 General description of fisheries

In the GSA09 the blue and red shrimp is one of the most important target species of the fishery carried out on the muddy bottoms of the upper and middle slope. The species is exclusively exploited with otter bottom trawling.

The main fishing grounds are located in the northern part of the GSA09 (northern Ligurian Sea); they are mainly exploited by several trawlers of Sanremo and Santa Margherita Ligure which operate daily fishing trips.

Generally S. Margherita Ligure's trawlers leave the port between 3 and 5 a.m. and come back late in the afternoon, while during the main fishing season, in summer, come back between 9 and 10.30 p.m. The customary fishing grounds are situated between Genoa and the bathyal grounds off the Santa Lucia Bank and the Gorgona Isle, representing the largest fishing area of the Ligurian trawlers fleets (Fig. 6.5.2.1.1). The trawlers are moored at buoys closed to the port mole. The catches of each boat are landed by their own tenders in the S. Erasmo wharf. A consistent part of landings is sold in the local market, directly by the fishermen; the most valuable qualities are picked up by a local wholesolder, while the massive product is taken to the Genoa's market.

The usual fishing grounds of Sanremo's trawlers are situated between the France border, at west, and the S. Lorenzo Point, at east (Fig. 6.5.2.1.1). Most of the boats fishing on the bathyal canyons of Ventimiglia, San Remo and San Lorenzo, leave the harbour between the 3 and 4 a.m. and come back between 6 and 8 p.m. Landings are taken up and sold by whole solder.

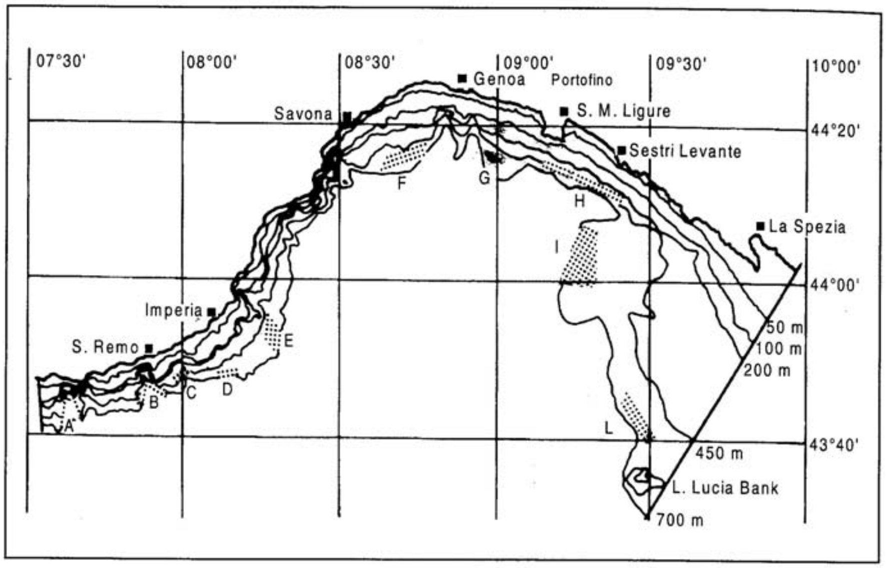


Fig. 6.5.2.1.1 Main fishing areas of *A. antennatus.* A: Ventimiglia Canyon; B: Sanremo Canyon; C: San Lorenzo Canyon; D: Vapore Bank; E: Capo Mele Bank; F: Arenzano Bank; G: Banchetto Bank; Di terra le rame Canyon; I: Di fuori le rame Bank; L: S. Lucia Bank (Fiorentino et al., 1998).

In Figure 6.5.2.1.2 are shown LPUE (from March 2009 to May 2010) of Sanremo and S. Margherita Ligure which represent the two main fleet exploiting blue and red shrimps in the GSA09 (Mannini, 2010).

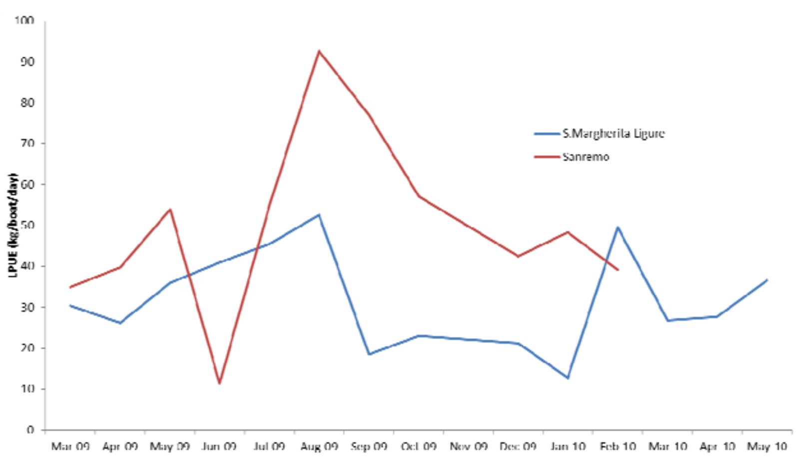


Fig.6.5.2.1.2 *A. antennatus* LPUE of Santa Margherita Ligure and Sanremo from March 2009 to May 2010.

The age structure of the landings, according to the DCR data, shows that the catch ranged between the age classes 2+ and 7+ (Fig.6.5.2.1.3); in the 2008 is noticeable the presence of juveniles.

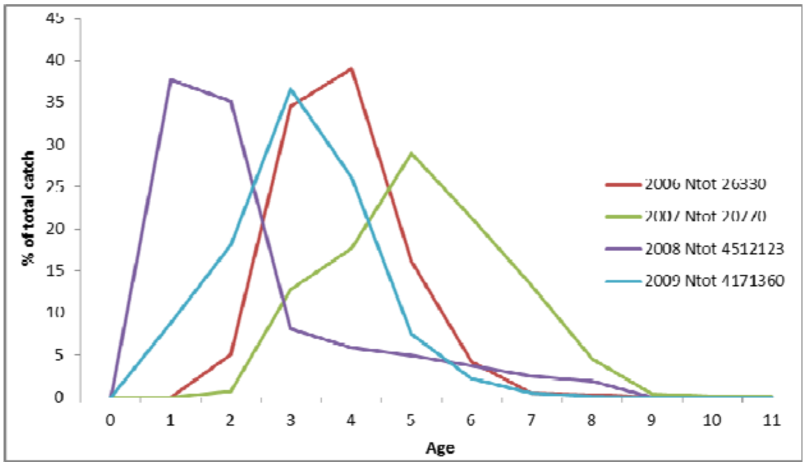


Fig.6.5.2.1.3 Age frequency distribution of *A. antennatus* landed in the GSA 09 from 2006 to 2009.

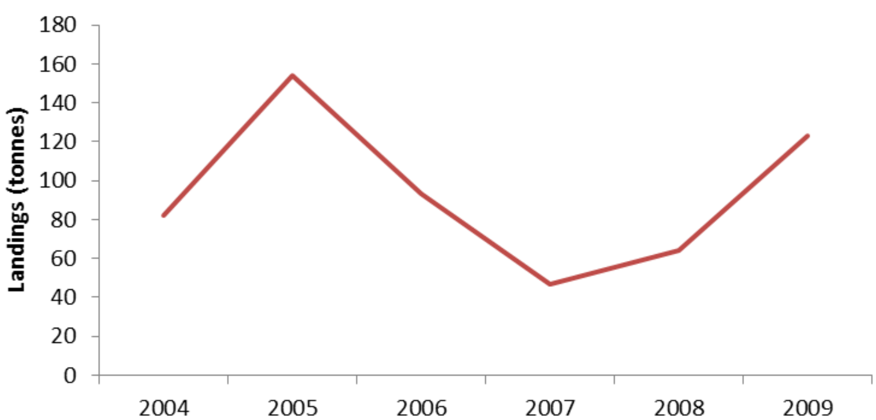
6.5.2.2 Management regulations applicable in 2010 and 2011

EC regulation 1967/2006 don't provide for a minimum length size for this species. Italian national law provided in the last years a fishing ban of a month which, for the Ligurian fleet, is enforced after the summer fishing season.

6.5.2.3 Catches

6.5.2.3.1 Landings

Total landings of blue and red shrimps fluctuated from about 80 tons in 2004 to 120 tons in 2009, showing a peak in 2005 corresponding to about 150 tons (Fig. 6.5.2.3.1.1; Tab. 6.5.2.3.1.1). The landings are entirely taken by two segments of the fleets, the so-defined deep and mixed otter trawlers. Seasonality fluctuations are a proper characteristic of the landings of this species, as shown by the LPUE produced by the fleet of Santa Margherita Ligure in the period 1987-1996 (Fig. 6.5.2.3.1.2).



6.5.2.3.1.1 Total landings in GSA 09.

Tab. 6.5.2.3.1.1 Annual landings (t) by fishing technique in GSA 09 as provided through the official DCF data call 2010.

COUNTRY	YEAR	GEAR	FISHERY	AREA	SPECIES	LANDINGS	TOTAL LANDINGS
ITA	2004	OTB	MDDWSP	SA 9	ARA	82.41	82.41
ITA	2005	OTB	MDDWSP	SA 9	ARA	154.46	154.46
ITA	2006	OTB	MDDWSP	SA 9	ARA	92.70	92.70
ITA	2007	OTB	MDDWSP	SA 9	ARA	47.37	47.37
ITA	2008	OTB	DWSP	SA 9	ARA	30.83	63.46
ITA	2008	OTB	MDDWSP	SA 9	ARA	32.63	
ITA	2009	OTB	DWSP	SA 9	ARA	69.46	123.50
ITA	2009	OTB	MDDWSP	SA 9	ARA	54.04	

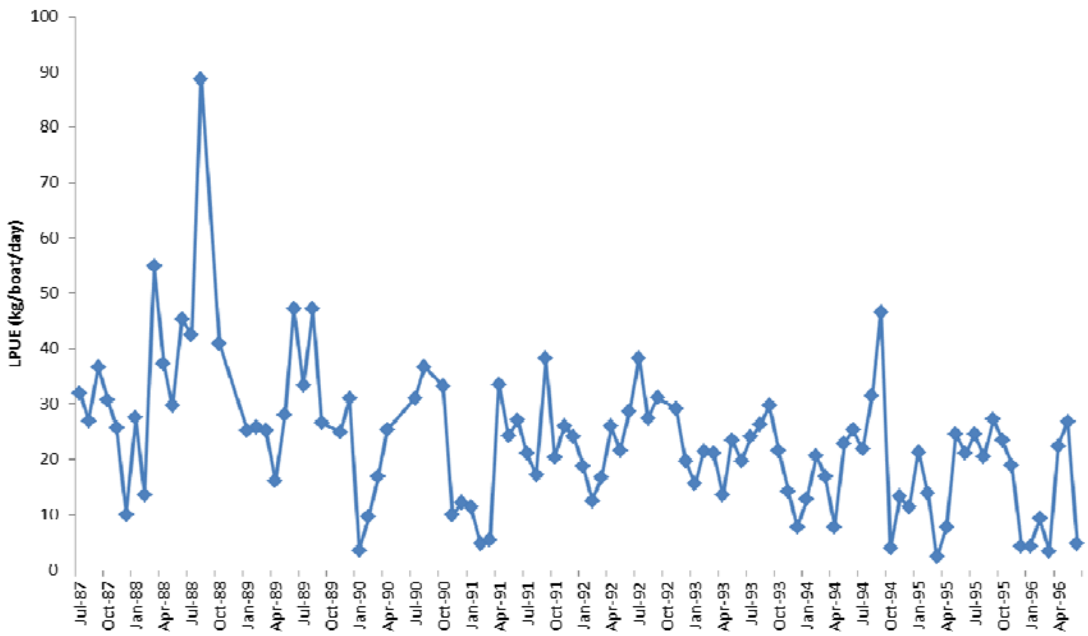


Fig. 6.5.2.3.1.2 Time series of LPUE of Santa Margherita Ligure from July 1987 to October 1996

The recruitment event seen in the survey data of 2008-2009 is confirmed also in the length at age distribution of the commercial landings (Fig. 6.5.2.3.1.3).

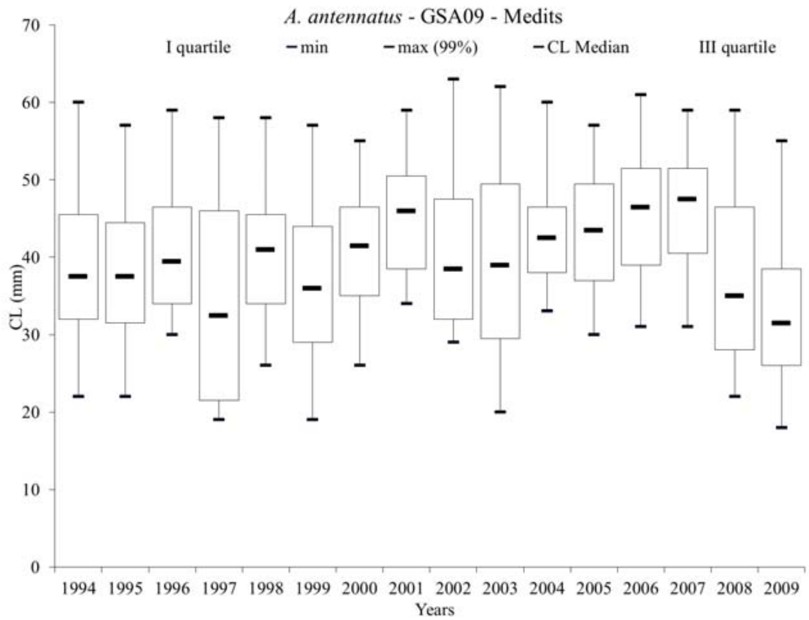


Fig. 6.5.2.3.1.3 Parameters of length frequencies from commercial landings/

6.5.2.3.2 Discards

Discarding of *A. antennatus* was not observed.

6.5.2.3.3 Fishing effort

The trends in fishing effort by fishing technique are listed in Tab. 6.5.2.3.3.1. Since 2006, the effort of the mixed fishery trawler fleet decreased, while in the last two years deep fishery activity did increase (Figure 6.5.2.3.3.1).

Tab. 6.5.2.3.3.1Trends in annual fishing effort as nominal effort (kW*days) and GT*days at sea by fishing technique deployed in GSA09 from 2004 to 2009.

COUNTRY	AREA	YEAR	VESSEL_LENGTH	GEAR	FISHERY	NOMINAL EFFORT	TOTAL NOMINAL EFFORT BY FISHERY	TOTAL NOMINAL EFFORT	GT DAYS AT SEA	TOTAL GT DAYS AT SEA BY FISHERY	TOTAL GT DAYS AT SEA
ITA	SA 9	2004	VL1824	OTB	MDDWSP	5857423	7976571	7986777	1114511	1386271	1388728
ITA	SA 9	2004	VL1218	OTB	MDDWSP	2119148			271760		
ITA	SA 9	2004	VL1824	OTB	DWSP	10206	10206		2457	2457	
ITA	SA 9	2005	VL1824	OTB	MDDWSP	10065218	12729333	12729333	1847675	2172726	2172726
ITA	SA 9	2005	VL1218	OTB	MDDWSP	2664115			325051		
ITA	SA 9	2006	VL1824	OTB	MDDWSP	7321573	9684257	9684257	1492922	1777239	1777239
ITA	SA 9	2006	VL1218	OTB	MDDWSP	2362684			284317		
ITA	SA 9	2007	VL1824	OTB	MDDWSP	6236446	8755987	8755987	1085312	1494042	1494042
ITA	SA 9	2007	VL1218	OTB	MDDWSP	2519541			408730		
ITA	SA 9	2008	VL1218	OTB	MDDWSP	1177098	2430709	2652398	225813	465453	520826
ITA	SA 9	2008	VL1824	OTB	MDDWSP	1253611			239640		
ITA	SA 9	2008	VL1218	OTB	DWSP	145852	221689		39778	55373	
ITA	SA 9	2008	VL1824	OTB	DWSP	75837			15595		
ITA	SA 9	2009	VL1824	OTB	MDDWSP	1372778	2018695	2504493	260243	349721	436125
ITA	SA 9	2009	VL1218	OTB	MDDWSP	583020			73621		
ITA	SA 9	2009	VL2440	OTB	MDDWSP	62897			15857		
ITA	SA 9	2009	VL1218	OTB	DWSP	320102	485798		39096	86404	
ITA	SA 9	2009	VL1824	OTB	DWSP	165696			47308		

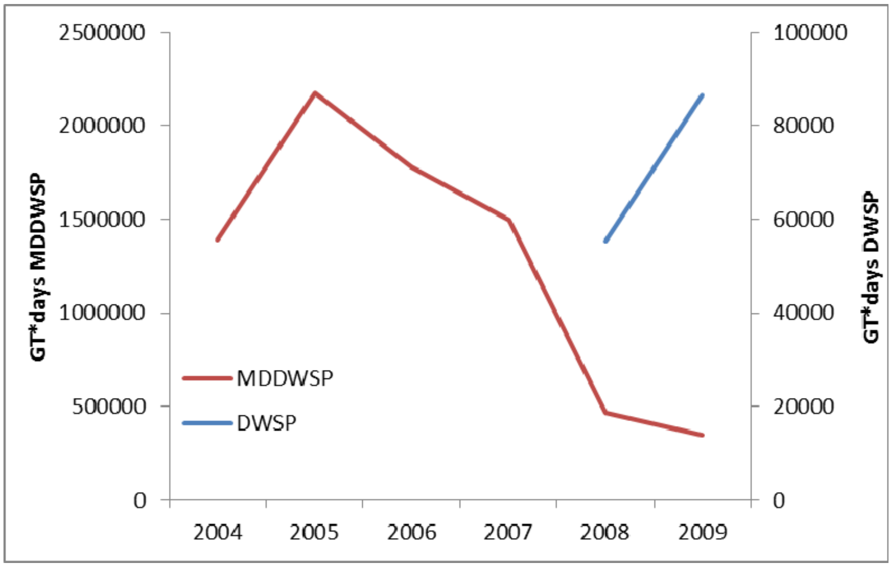


Fig. 6.5.2.3.3.1 Trend in annual fishing effort (GT*days at sea) by deep water fishery (DWSP) and mixed fishery (MDDWSP).

6.5.3 Scientific surveys

6.5.3.1 MEDITS

6.5.3.1.1 Methods

Since 1994 two trawl surveys are regularly carried out each year: MEDITS, in spring, and GRUND, in autumn. The two surveys gave a similar temporal trend in density and biomass of blue and red shrimp and large fluctuations are present from year to year (Fig. 6.5.3.1.1.1).

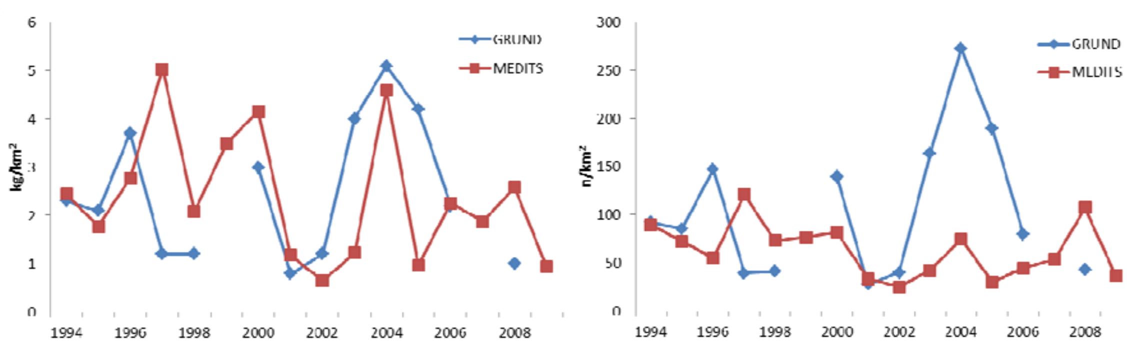


Fig. 6.5.3.1.1.1 *A. antennatus*: GRUND and MEDITS trends in density and biomass from 1994 to 2009 in GSA 09.

Based on the DCR data call, abundance and biomass indices were recalculated. In GSA09 the following number of hauls was reported per depth stratum (Tab. 6.5.3.1.1.1).

Tab. 6.5.3.1.1.1. Number of hauls per year and depth stratum in GSA09, 1994-2009.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GSA09_010-050	19	18	18	18	19	18	18	18	13	13	13	14	13	13	13	14
GSA09_050-100	19	20	18	19	18	19	20	20	15	15	15	14	16	16	13	14
GSA09_100-200	35	35	36	35	35	35	34	34	26	27	26	27	25	26	28	27
GSA09_200-500	32	33	33	36	32	36	37	35	27	27	27	28	29	33	30	28
GSA09_500-800	31	30	31	28	30	28	27	29	24	22	21	20	20	17	18	20

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Catches by haul were standardized to 60 minutes hauling duration. The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$
$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$
Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean
The variation of the stratified mean is then expressed as the 95 % confidence interval:
Confidence interval = Yst ± t(student distribution) * V(Yst) / n

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA.

6.5.3.1.2 Geographical distribution patterns

The stock is more abundant in the northern part of the GSA (Ligurian Sea) as showed in Figure 6.5.3.1.2.1 (from Ardizzone *et al*., Eds. CD-ROM Version)

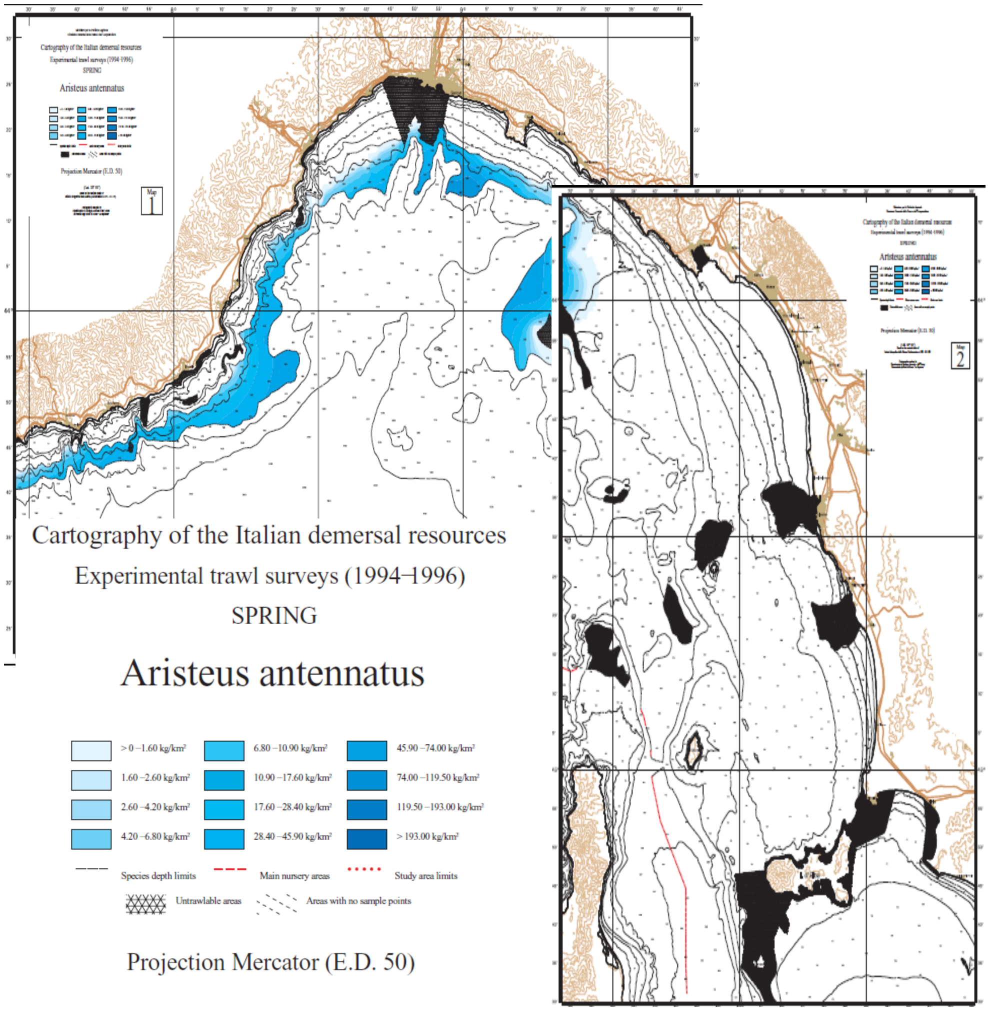


Fig. 6.5.3.1.2.1 *A. antennatus*: Adult specimens biomass 1994-1996, GSA09 (Ligurian Sea).

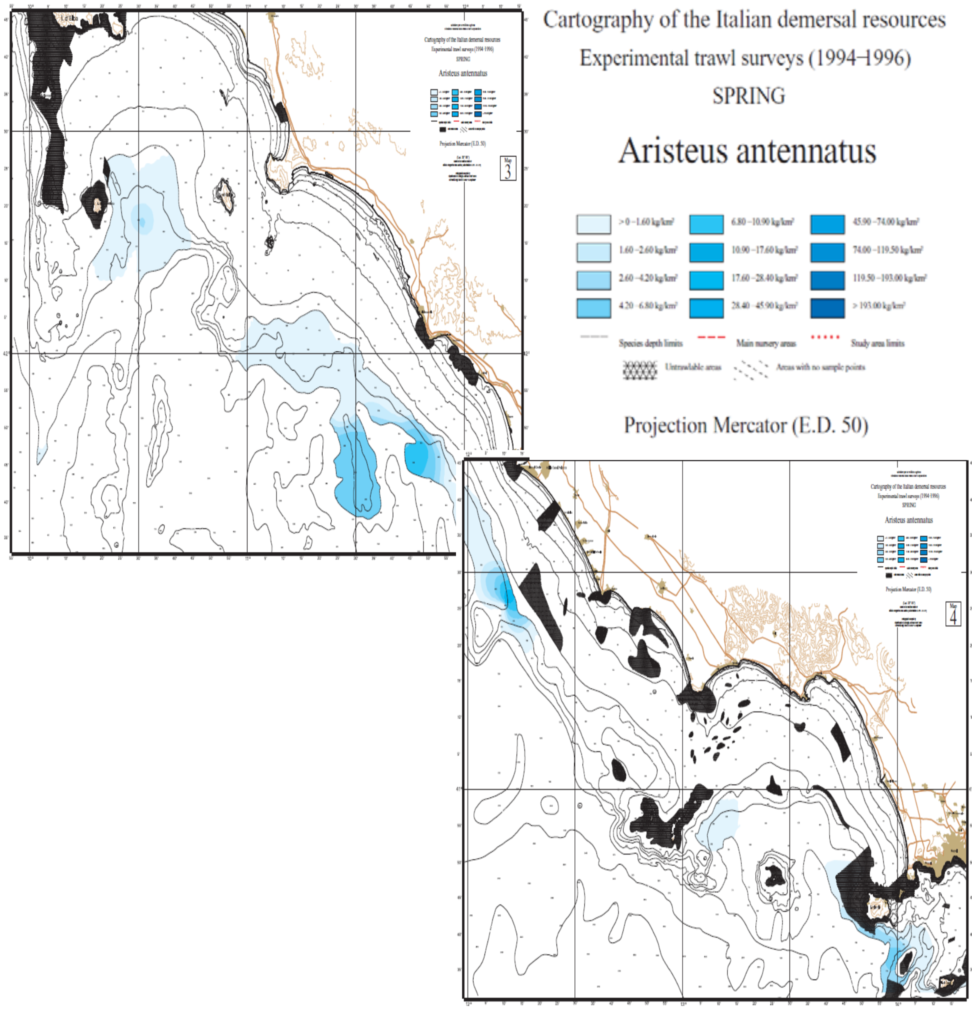
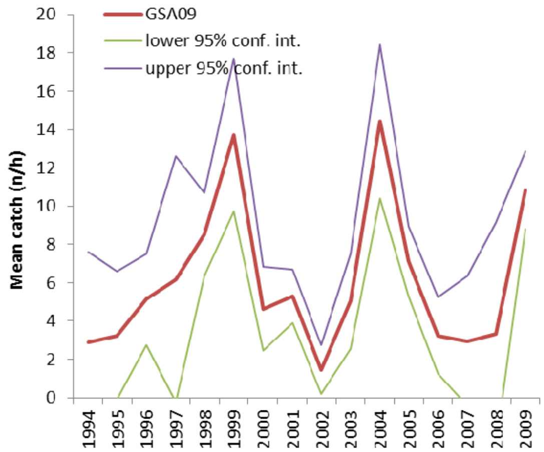


Fig. 6.5.3.1.2.2 *A. antennatus*: Adult specimens biomass 1994-1996, GSA09 (Northern and central Tyrrhenian Sea).

6.5.3.1.3 Trends in abundance and biomass

Fishery independent information regarding the state of the blue and red shrimp in GSA09 was derived from the international survey MEDITS. Figure 6.5.3.1.3.1 displays the estimated trend in *A. antennatus* abundance and biomass in GSA 09. The estimated abundance and biomass indices do not reveal a clear trend. In the period analyzed (2006-2009) abundance indices showed a stationary phase followed by an increase in 2009 while biomass indices showed a decrease in the same year.



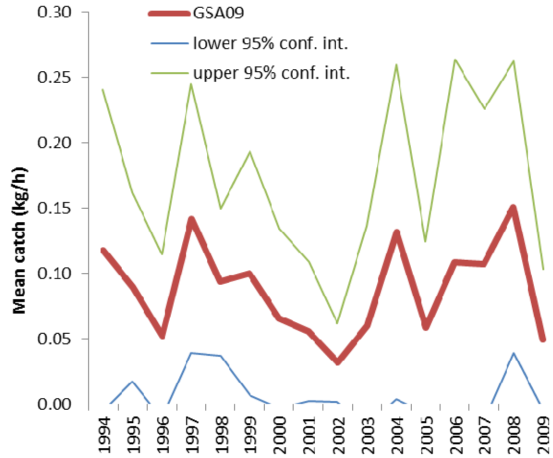


Fig. 6.5.3.1.3.1 Abundance and biomass indices of blue and red shrimp in GSA09.

6.5.3.1.4 Trends in abundance by length or age

The following Fig. 6.5.3.1.4.1 and 2 display the stratified abundance indices of GSA 09 in 1994-2009.

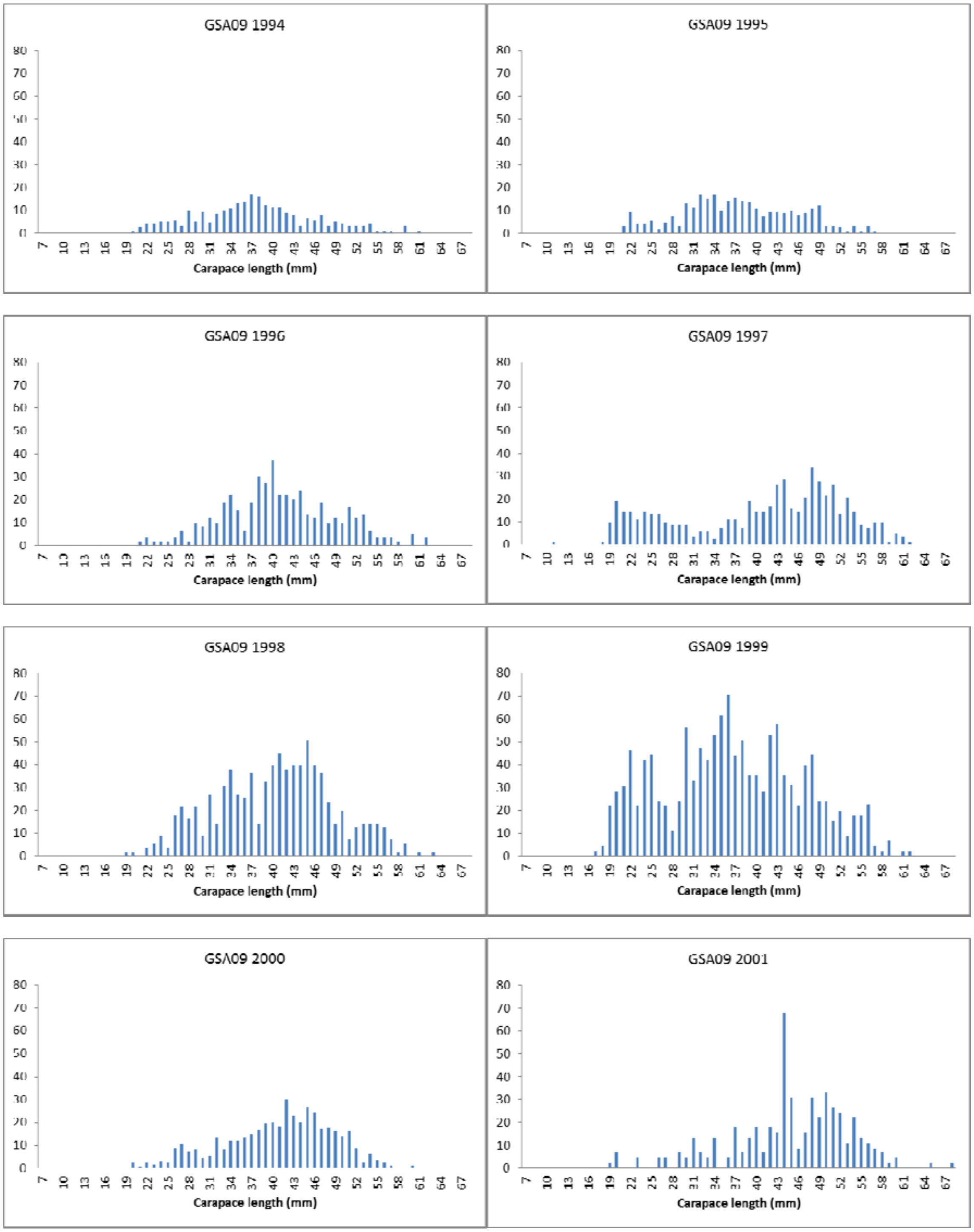


Fig. 6.5.3.1.4.1 Stratified abundance indices by size, 1994-2001.

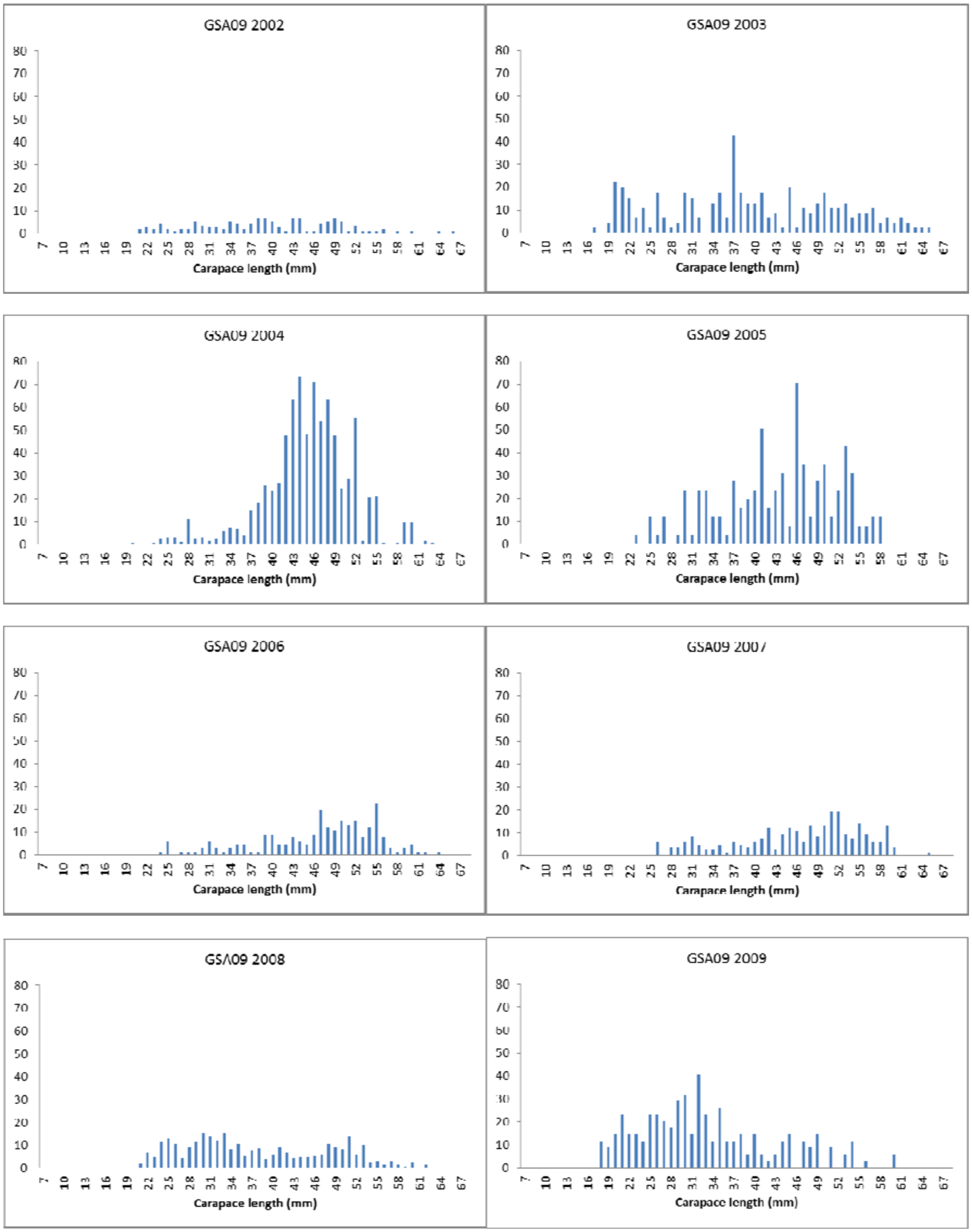


Fig. 6.5.3.1.4.2 Stratified abundance indices by size, 2002-2009.

6.5.3.1.5 Trends in growth

No analyses were conducted during EWG-11-05.

6.5.3.1.6 Trends in maturity

No analyses were conducted during EWG-11-05.

6.5.4 Assessment of historic stock parameters

6.5.4.1 Method 1: LCA

6.5.4.1.1 Justification

The pseudo-cohort analysis VIT was applied using data from 2006 to 2009.

6.5.4.1.2 Input parameters

Data from DCF provided at EWG-11-05 contained information on blue and red shrimp landings and the respective size structure for 2006-2009. A VPA was performed using a Length Cohort Analysis (LCA) and applying the routine included in the VIT package designed by Lleonart and Salat (1992) for each year separately. Data used are reported in Tab. 6.5.4.2.1.1 and biological parameters listed in Tab. 6.5.4.1.2.2. A natural mortality vector computed by ProdBiom was used. Analysis were computed only on females since red shrimp fishery mainly exploits this fraction of the stock.

Tab. 6.5.4.2.1.1. Input data for LCA of blue and red shrimp in GSA 09.

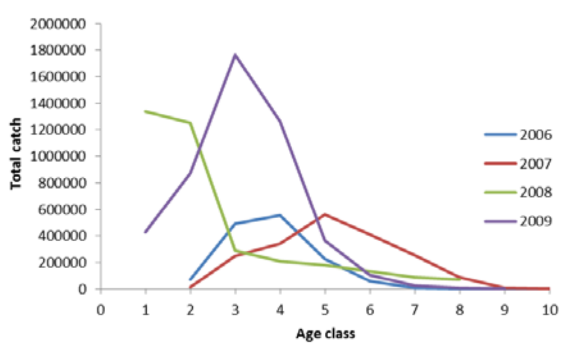
• **Growth**
$L\infty$ =76.9 mm carapace length
K = 0.21
t0 = -0.019
• **Length-Weight relationships**
a = 0.0029
b = 2.449
• **Natural mortality**
Mvector = 0.75 (age 1), 0.49 (age 2), 0.40 (age 3), 0.36 (age 4),0.33 (age 5), 0.32 (age 6), 0.30 (age 7), 0.29 (age 8), 0.29 (age 9), 0.28 (age 10)
• **Length maturity**
L_{50}=35mmCL (Spedicato *et al.*, 1995)

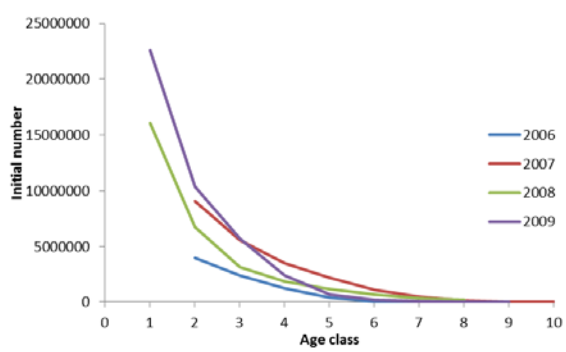
Tab. 6.5.4.2.1.2. Input data for LCA Catch at length (thousands) 2006-2009.

Carapace Length Class (cm)	2006	2007	2008	2009	Carapace Length Class (cm)	2006	2007	2008	2009
1.7	0	0	23144	8582	4.1	0	0	46705	197337
1.8	0	0	46289	2223	4.2	38288	13302	57276	195014
1.9	0	0	46289	5636	4.3	0	0	71377	223846
2.0	0	0	115722	21775	4.4	36649	9470	55075	193568
2.1	0	0	138866	24608	4.5	0	0	14319	160226
2.2	0	0	324021	41742	4.6	36726	18337	36571	186596
2.3	0	0	324021	33790	4.7	0	0	38554	140149
2.4	0	0	462888	71046	4.8	20485	28379	55293	165977
2.5	0	0	418582	87870	4.9	0	0	71813	157599
2.6	0	1501	347166	72516	5.0	7237	31419	30621	86814
2.7	0	0	347166	71180	5.1	0	0	55293	113284
2.8	0	0	208299	70249	5.2	8737	20791	51108	74554
2.9	0	0	115722	53768	5.3	0	0	49343	58343
3.0	2071	0	249273	58931	5.4	1487	31922	51326	41972
3.1	0	0	18504	71958	5.5	0	0	42957	26204
3.2	8451	0	55511	71259	5.6	661	12959	34806	32599
3.3	0	0	28638	76765	5.7	0	0	40974	0
3.4	11850	0	32823	134858	5.8	826	8151	38990	0
3.5	0	0	43175	143704	5.9	0	0	14319	0
3.6	26273	7362	53091	146380	6.0	0	647	6168	0
3.7	0	0	57058	165929	6.1	0	0	12336	0
3.8	31273	7119	56840	205210	6.2	165	323	0	0
3.9	0	0	61024	166389	6.4	0	0	0	0
4.0	32071	16001	56621	225605	6.5	0	0	6168	0

6.5.4.1.3 Results

Blue and red shrimp landings are concentrated on adults of age classes 2 onward. High landings were observed in 2008 and 2009. In 2009 and in particular in 2008 high catches of juveniles was observed. Fishing mortality impact specimens of age classes 2-3 onward (Fig. 6.5.4.1.3.1). Even though analysis was performed for each year, the EWG 11-05 agreed to the opportunity to consider only the results coming from the first two years in order to be more consistent with the steady state assumption of LCA method (Jones, 1981). In Fig. 6.5.4.1.3.2 biomass per recruit and yield per recruit curves of *A. antennatus* females in the GSA09 are shown





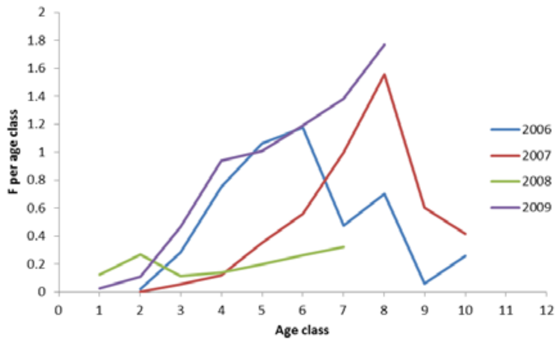


Fig.6.5.4.1.3.1 LCA outputs: catch numbers, numbers-at-age and fishing mortality at age of *A. antennatus* in the GSA09.

6.5.5 Long term prediction

6.5.5.1 Justification

The yield per recruit from the VIT was applied.

6.5.5.2 Input parameters

The length frequency data from 2006 and 2007 and the biological parameters were used as given in table 6.5.5.2.1.

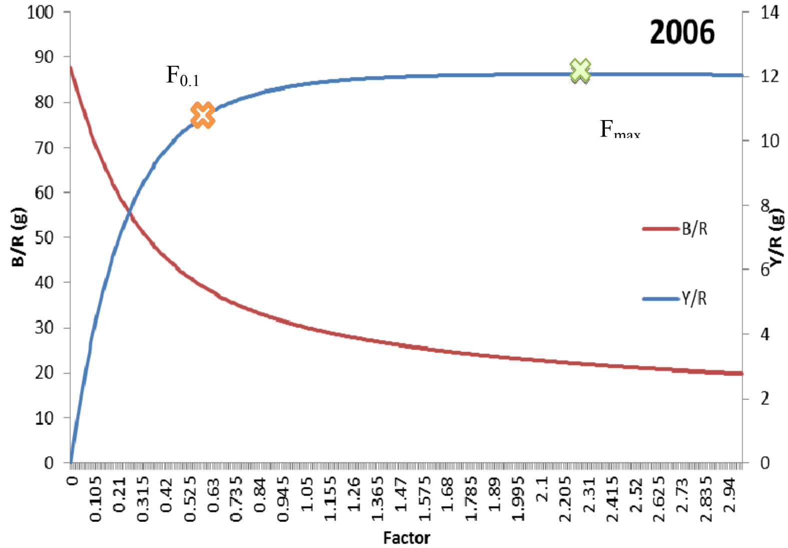
Tab. 6.5.5.2.1 Input data for YpR analysis.

1.1.1.1.1 Growth
L8 =76.9 mm carapace length
K = 0.21
t0 = -0.019
1.1.1.1.2 Length-Weight relationships
a = 0.0029
b = 2.449
1.1.1.1.3 Natural mortality
Mvector = 0.75 (age 1), 0.49 (age 2), 0.40 (age 3), 0.36 (age 4),0.33 (age 5), 0.32 (age 6), 0.30 (age 7), 0.29 (age 8), 0.29 (age 9), 0.28 (age 10)
1.1.1.1.4 Length maturity
L_{50}=35mmCL (Spedicato *et al.*, 1995)

Carapace Length Class (cm)	2006	2007
2.6	0	1501
2.8	0	0
3.0	2071	0
3.2	8451	0
3.4	11850	0
3.6	26273	7362
3.8	31273	7119
4.0	32071	16001
4.2	38288	13302
4.4	36649	9470
4.6	36726	18337
4.8	20485	28379
5.0	7237	31419
5.2	8737	20791
5.4	1487	31922
5.6	661	12959
5.8	826	8151
6.0	0	647
6.2	165	323

6.5.5.3 Results

The resulting YpR (gr.) and BpR are illustrated in the following figures. All ages reference point $F_{0.1}$=0.32.



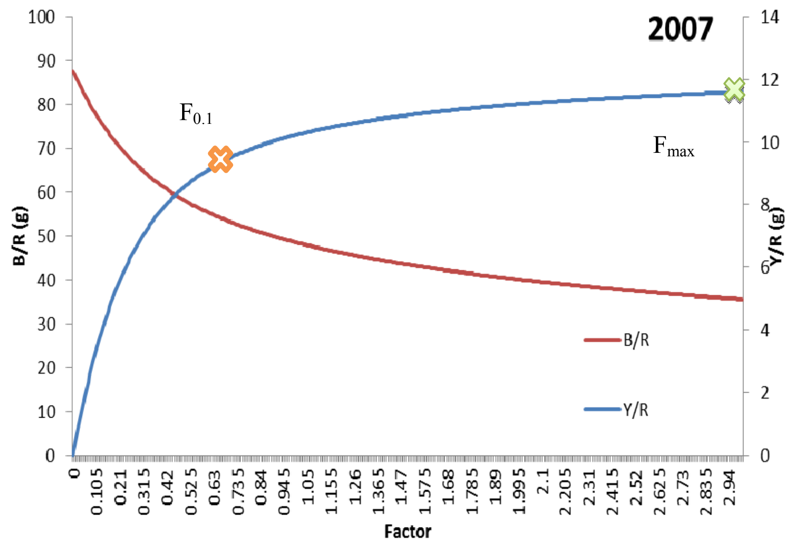


Fig. 6.5.5.3.1 LCA outputs: Biomass per recruit (left) and yield per recruit (right) curves of *A. antennatus* females in the GSA09. The multiplicative factor of current F (factor =1) corresponding to $F_{0.1}$ and F_{max} are shown.

6.5.6 Data quality

Medits survey data were available from 1994. A check of abundance and biomass indexes needs to be done. Landing at age distribution of 2008 and 2009 seems not suitable to gain steady state condition to respect constrains of LCA.

6.5.7 Scientific advice

6.5.7.1 Short term considertations

6.5.7.1.1 State of the stock size

Stock assessment has been computed by Length Cohort Analysis (VIT software) using DCF data of landings at age (2006-2009). Results obtained didn't show a clear trend in the stock size. Medits survey indices show a variable pattern of abundance (n/h) and biomass (kg/h) without a clear trend. Since no precautionary level for the stock of blue and red shrimp in GSA09 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

6.5.7.1.2 State of recruitment

Box-plot of Medits length frequency distributions have shown that in the last two years analyzed (2008-2009) an important recruitment took place in the area. The high recruitment event of 2008-2009 is confirmed also in the length at age distribution of the commercial landings.

6.5.7.1.3 State of exploitation

EWG 11-05 proposes $F_{0.1} \leq 0.32$ as limit management reference point consistent with high long term yields (F_{MSY} proxy).

According to the F estimates obtained using Length Cohort Analysis, average F_{2-10} (0.529 in 2006 and 0.517 in 2007; mean 0.523) was over the average estimated $F_{0.1}$ values (0.298 in 2006 and 0.333 in 2007; mean 0.316). In this case, the stock would not appear to be able to sustain the current level of fishing effort in the GSA09 and thus EWG 11-05 considers the stock to be subject to overfishing.

It is important to consider that this stock could be strongly affected by environmental and ecological factors (e.g. water temperature, predation) which may alter the conclusion regarding its exploitation status.

6.6 Stock assessment of spottail mantis shrimp in GSA 09

6.6.1 Stock identification and biological features

6.6.1.1 Stock Identification

The mantis shrimp, *Squilla mantis*, is found in Mediterranean waters and in the adjacent Atlantic, where it has been reported from the Gulf of Cadiz and from the Canary Islands and Madeira, its southernmost distribution being Angola.

It is a demersal species distributed on sandy and muddy bottoms of the continental shelf, from 3 m to around 150 m depth, but occasionally deeper (350 m depth). Mantis shrimp is present in high densities in areas with suitable burrowing substrates (fine sand and sandy mud), especially where the influence of river run-off is important. It is a strongly sedentary species and the seasonal trends appearing in catch data series are not so much due to temporal changes in its distribution (limited migratory habits), as to its reproductive and burrowing behaviour, as linked to recruitment patterns.

The mating season occurs from winter to spring (January to June), when females have their cement glands active, although the activity of these glands may start as early as October. Eggs are shed from April to June. In spring and early summer, females incubate the eggs in their burrows. During incubation, females do not leave their burrows. In the eastern Ligurian Sea (GSA 09), females with mature gonads were found from January to June, with a clear peak in April; this trend was also confirmed by the monthly development of the maturity stages (and further confirmed by the gonadosomatic index), that reached maximum values in March-April.

Due to a lack of information about the stock identification of mantis shrimp population in the western Mediterranean, this stock was assumed to be confined within the GSA 09 boundaries. As a matter of fact, there is not any available definition of unit stocks neither based on genetics, bio-chemistry, fishery-based nor on any alternative method based on somatic features. Under a management point of view, in the frame of GFCM, it has been decided, when the lack of any evidence does not allow suggesting an alternative hypothesis, that inside each one of the GSAs boundaries inhabits a single, homogeneous mantis shrimp stock that behaves as a single well-mixed and self-perpetuating population.

The hypothesis of a single stock of mantis shrimp in GSA9, which includes waters belonging to 2 seas (Ligurian and Tyrrhenian) separated by the Elba Island and fleets that do not show any spatial overlapping is almost unlikely.

6.6.1.2 Growth

The growth has not been recently studied in GSA 09. In the past studies carried out on a limited part of the area showed that the maximum sizes caught (37-40 mm CL) in the fishery would correspond to 3-year old individuals. For the analyses a combination of the following set of parameters estimated for the Adriatic Sea have been adopted: $L\infty = 41.2$, $K=0.53$ for males and $L\infty = 41.9$, $K=0.45$ for females. The life cycle is of about 5 years. The growth rates by age seem to be quite similar between the two sexes.

6.6.1.3 Maturity

Size at maturity for females is 20-24 mm CL, when considering maturity by the development of the cement glands; female *Squilla mantis* mature within 1 year of settlement to the bottom and spawn within their second year of life.

6.6.2 Fisheries

6.6.2.1 General description of fisheries

Although in GSA 09 the species is exploited by different types of gears, the majority of the landing comes from trawling. The annual landing for 2009 was due for 95% to bottom trawl (381 tons), for 2.25% to Gillnet (9 tons) and for 2.25% to trammel net (9 tons).

About 200 bottom trawlers exploit this resources all year round in the coastal area. Mantis shrimp is caught as a part of a species mix that constitutes the target of the trawlers operating on the continental shelf near shore. The main species caught in GSA9 associated with mantis shrimp are *Sepia officinalis, Trigla lucerna, Merluccius merluccius, Mullus barbatus, Octopus vulgaris.* Trawl catch is mainly composed by age 1 and 2 individuals while the older age classes are poorly represented in the catch. As concerns artisanal fisheries, *S. mantis* is a by catch of by gillnet and trammel net targeting other species in the coastal area.

The burrowing behaviour of *Squilla mantis* makes it vulnerable only when individuals are out of their burrows and this occurs mainly at night, between sunset and sunrise. Seasonal variations in catchability result from reduced out-of-burrow activity, because females rarely exit their burrow when they are incubating their egg mass in spring and early summer. Conversely, catches are much increased in winter, when mating takes place. Catches are further increased in late autumn with the incorporation of new recruits. The reproductive behaviour the species also influences the relative proportion of males and females in the catches by season: females outnumber males only in winter (mating season), while the sex-ratio is biased towards males in spring and summer. Additionally, weather and sea conditions represent an important influence on the catchability of this species as catches increase after prolonged bad weather conditions probably because of disturbance of the burrow systems as a result of the high turbidity.

6.6.2.2 Management regulations applicable in 2010 and 2011

- Minimum landing sizes: None.
- Fishing closure for trawling: 30-45 days in late summer (not every year have been enforced).
- Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets have been replaced with a cod end with 40 mm (stretched) square meshes or a cod end with 50 mm (stretched) diamond meshes.
- Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast. However, towed gears are always forbidden inside 1.5 miles from the coast with the exception of some areas of the Ligurian Sea that have benefited from the derogation according by the EC Regulation 1967/2006 for the Mediterranean Sea.
- Two small No Take Zones ("Zone di Tutela Biologica", ZTB) are present inside the GSA 09; one off the Giglio Island (50 km^2, northern Tyrrhenian Sea) another off Gaeta, (125 km^2, central Tyrrhenian Sea). Bottom fishing was not allowed in the two ZTB. A recent regulation of the Italian Ministry of Agricultural, Food and Forestry Policies has established that fishing activity can be carried out in these two areas from July 1st to December 31st.

6.6.2.3 Catches

6.6.2.3.1 Landings

The total landing showed a decreasing trend in the period 2004-2009 (Fig. 6.6.2.3.1.1 and Tab. 6.6.2.3.1.1), with maximum value in 2005 (590 tons) and minimum in 2008 (394 tons). The species is mainly landed by the trawl fleet (OTB) fishing on the continental shelf. A fluctuating trend in the landing of OTB is observed, with lower values in the last two years. This tendency seems to be mainly due to the reduction in fishing effort observed for this type of gear, while the LPUE remained quite constant during the period analysed (Fig. 6.6.2.3.1.2). The decreasing trend in the landing is more evident for artisanal gears. In 2009 the landing of gillnet (GNS) and trammel net (GTR) was 18 tons, representing only the 4.5% of the total landing of the species. The LPUEs for these two gears show a significant reduction, particularly evident in the case of gillnet.

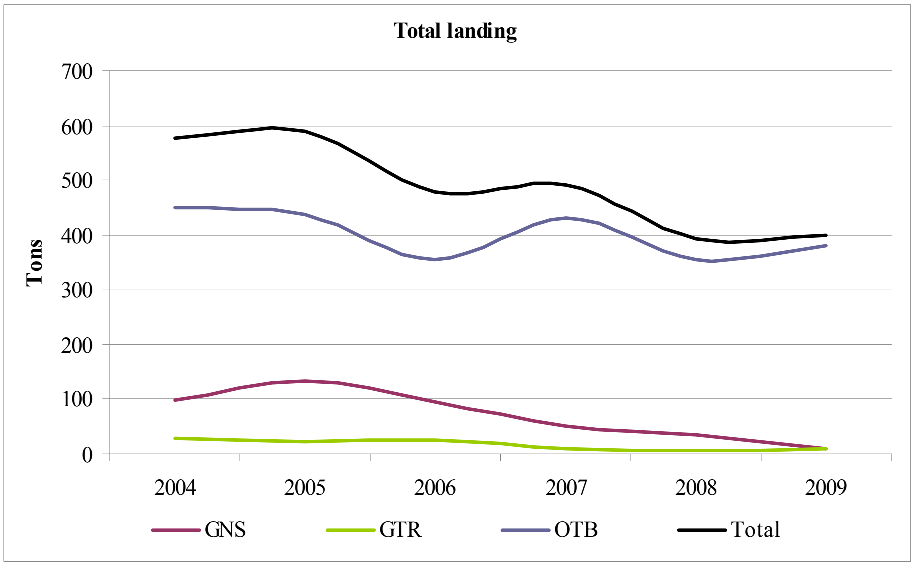


Fig. 6.6.2.3.1.1 Landings (in tons) from the trawl and small-scale fleets in the GSA 09 in the period 2004-2009 (official 2010 DCF data call). GNS: gillnets; GTR: trammel net; OTB: demersal trawling.

Tab. 6.6.2.3.1.1 Landings (in tons) of mantis shrimp as reported through the official 2010 DCF data call.

	2004	2005	2006	2007	2008	2009
Otter trawl	449	436	356	432	354	381
Gillnet	98	132	96	51	34	9
Trammel net	28	22	26	9	6	9
Total	575	590	478	492	394	399

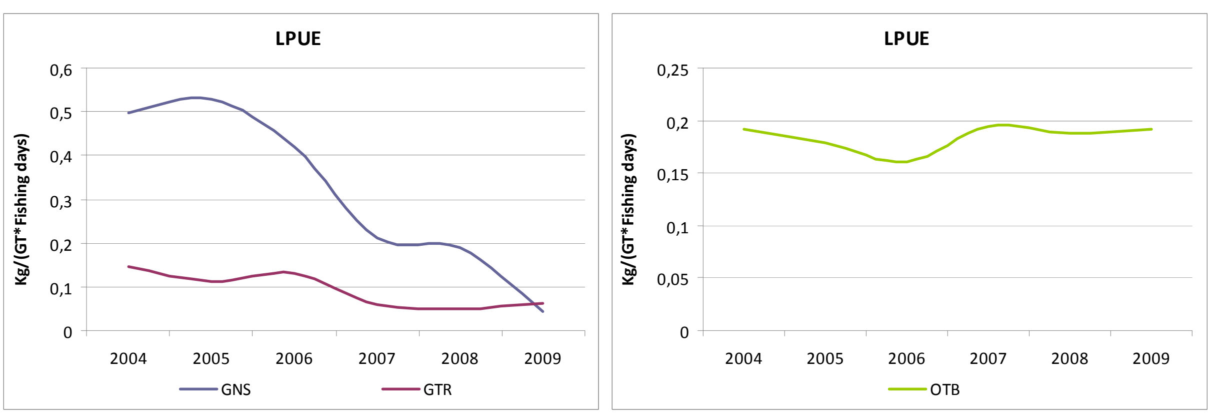


Fig. 6.6.2.3.1.2 Landing per Unit of Effort (LPUE) for set nets (left) and trawling (right) in the GSA 09 for the period 2004-2009 (official 2010 DCF data call). GNS: gillnets; GTR: trammel net; OTB: demersal trawling.

6.6.2.3.2 Discards

According to the data collected in 2009 in the framework of DCF, discard represented 3.4% of the trawling total catch (13.3 tons). This fraction is composed by non marketable small specimens. No information is available about the discard of set nets.

6.6.2.3.3 Fishing effort

The fishing capacity of the GSA 09 has shown in these last 10 years a progressive decrease. Fishing effort (GT*fishing days) performed by the GSA 09 trawlers fishing for demersal species decreased from about 2,342,000 in 2004 to about 1,986,000 in 2009. A decreasing trend has been detected also for trammel net, from 190,000 in 2004 to 143,000 in 2009, while gillnet showed a slightly increase from 197,000 in 2004 to 210,000 in 2009 (Fig. 6.6.2.3.3.1).

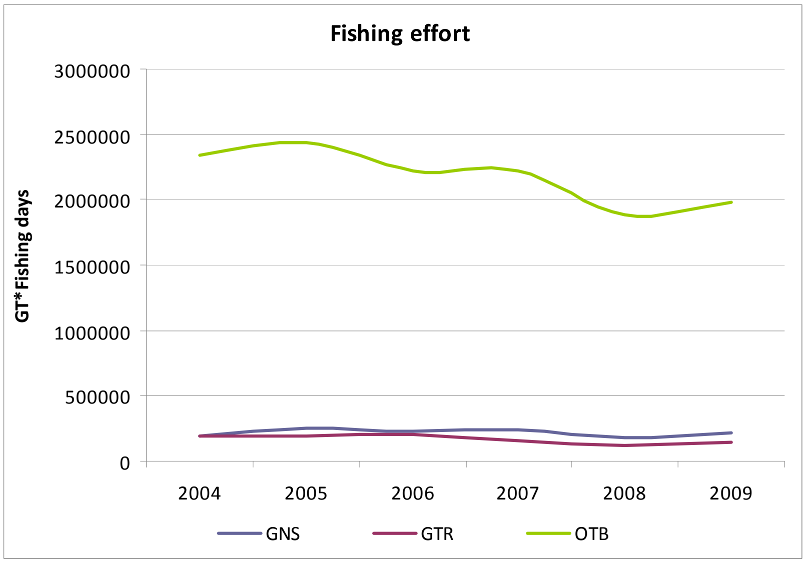


Fig. 6.6.2.3.3.1 Fishing effort (GT* fishing days) for the different type of gears in the GSA 09 during 2004-2009.

6.6.3 Scientific surveys

6.6.3.1 MEDITS

6.6.3.1.1 Methods

Based on the DCR data call, abundance and biomass indices were recalculated. In GSA01 the following number of hauls was reported per depth stratum (Tab. 6.6.3.1.1.1).

Tab. 6.6.3.1.1.1. Number of hauls per year and depth stratum in GSA09, 1994-2009.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GSA09_010-050	19	18	18	18	19	18	18	18	13	13	13	14	13	13	13	14
GSA09_050-100	19	20	18	19	18	19	20	20	15	15	15	14	16	16	13	14
GSA09_100-200	35	35	36	35	35	35	34	34	26	27	26	27	25	26	28	27
GSA09_200-500	32	33	33	36	32	36	37	35	27	27	27	28	29	33	30	28
GSA09_500-800	31	30	31	28	30	28	27	29	24	22	21	20	20	17	18	20

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Catches by haul were standardized to 60 minutes hauling duration. The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$
$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$
Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean
The variation of the stratified mean is then expressed as the 95 % confidence interval:
Confidence interval = $Yst \pm t$(student distribution) * $V(Yst) / n$

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA.

6.6.3.1.2 Geographical distribution patterns

No information was documented during EWG-05-11.

6.6.3.1.3 Trends in abundance and biomass

Fishery independent information regarding the state of the spottail mantis shrimp in GSA09 was derived from the international survey MEDITS. Figure 6.6.3.1.3.1 displays the estimated trend in abundance and biomass. The estimated abundance and biomass indices do not reveal a clear trend.

Although mantis shrimp is not a target species in the Medits survey, data collected allowed to estimate the density of the population. In Fig. 6.6.1.3.1 the trends of the number of specimens and biomass indices estimated for the depth stratum 0-200 m are reported. The two trends, very similar to each other, show a very high peak in 1996 and minimum values in the period 1997-2001. The last years are characterised by fluctuations without any trend.

Fig. 6.6.1.3.1 Trends of the number of specimens and biomass indices estimated for the depth stratum 0-200 m are reported..

6.6.3.1.4 Trends in abundance by length or age

No information was been documented.

6.6.3.1.5 Trends in growth

No information was been documented.

6.6.3.1.6 Trends in maturity

No information was been documented.

6.6.4 Assessments of historic stock parameters

6.6.4.1 Method 1: LCA

6.6.4.1.1 Justification

This is the first assessment of mantis shrimp in the GSA 09.

A LCA was performed aimed at the estimation of a vector of *F* at size, using data on total annual catches by size. Data used in the analysis cover only the trawling (including discard), as the set nets catches were negligible in 2009. Considering that only data for 2009 were available, it was not possible to perform a formal VPA. The software used to carry out the analyses was VIT.

6.6.4.1.2 Input parameters

Data, derived from commercial catches (landing and discard) by size/age for sexes combined were used to estimate F, the value of the $F_{0.1}$, the numbers at age and other features.

The length frequency distribution and the age frequency distribution landing are shown in Fig. 6.6.4.1.2.1 and in Fig. 6.6.4.1.2.2, respectively.

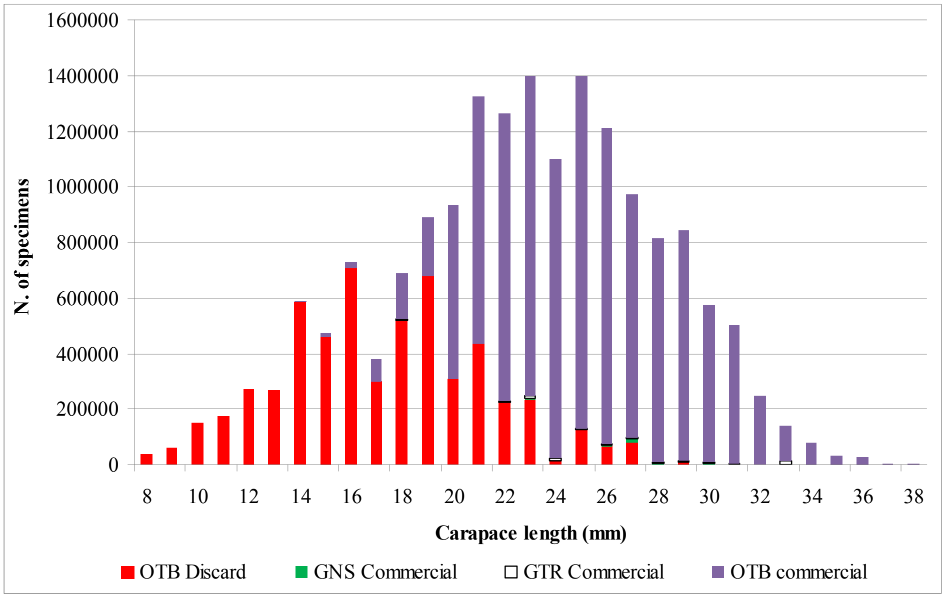


Fig. 6.6.4.1.2.1 Size frequency distributions of trawl fleet (OTB), gillnet (GNS) and trammel net (GTR) for the year 2009.

The exploited size range is comprised between 8 and 38 mm carapace length (CL), corresponding to specimens between 0+ and 5 age classes. The discarded specimens show a size range between 8 and 29 mm CL, the majority of them with a size comprised between 12 and 21 mm CL (0+ and 1 age classes). The trawl landing is composed by specimens between 14 and 38 mm CL, with higher abundances of the size classes comprised between 20 and 31 cm CL (1 and 2 age classes).

Fig. 6.6.4.1.2.2 Landings numbers at age for 2009.

Tab. 6.6.4.1.2.1 Landing numbers at age (in thousands), 2009.

Age class	OTB
0+	2070
1	9239
2	4235
3	390
4	38
5	6
Total	15978

The following set of parameters was used to perform the LCA:

Growth parameters (Von Bertalanffy)
$L\infty$ = 41.0 (mm, carapace length)
K = 0.5
to =
L*W
a = 0.099
b = 1.737
Natural mortality
M vector Age_1=1.42 , Age_2=0.63, Age_3=0.48, Age_4=0.41, Age_5=0.37, Age_6=0.36
Length at maturity (L_{50})
L_{50} = 20.0 mm CL
Proportion of matures
Age_1=0.04, Age_2=0.90, Age_3=1.00, Age_4=1.00, Age_5=1.00, Age_6=1.00

The vector of natural mortality M was estimated using the software Prodbiom.

6.6.4.1.3 Results

VIT results regarding the pattern of catch in biomass reconstruction by age, the initial number by age and the total and fishing mortality by age are showed in Fig. 6.6.4.1.3.1. The total catch in biomass is almost due to the fish of 1 and 2 age classes. Fishing mortality significantly affects the stock from 1 age class onward, with highest values on 2 and 3 age class individuals.

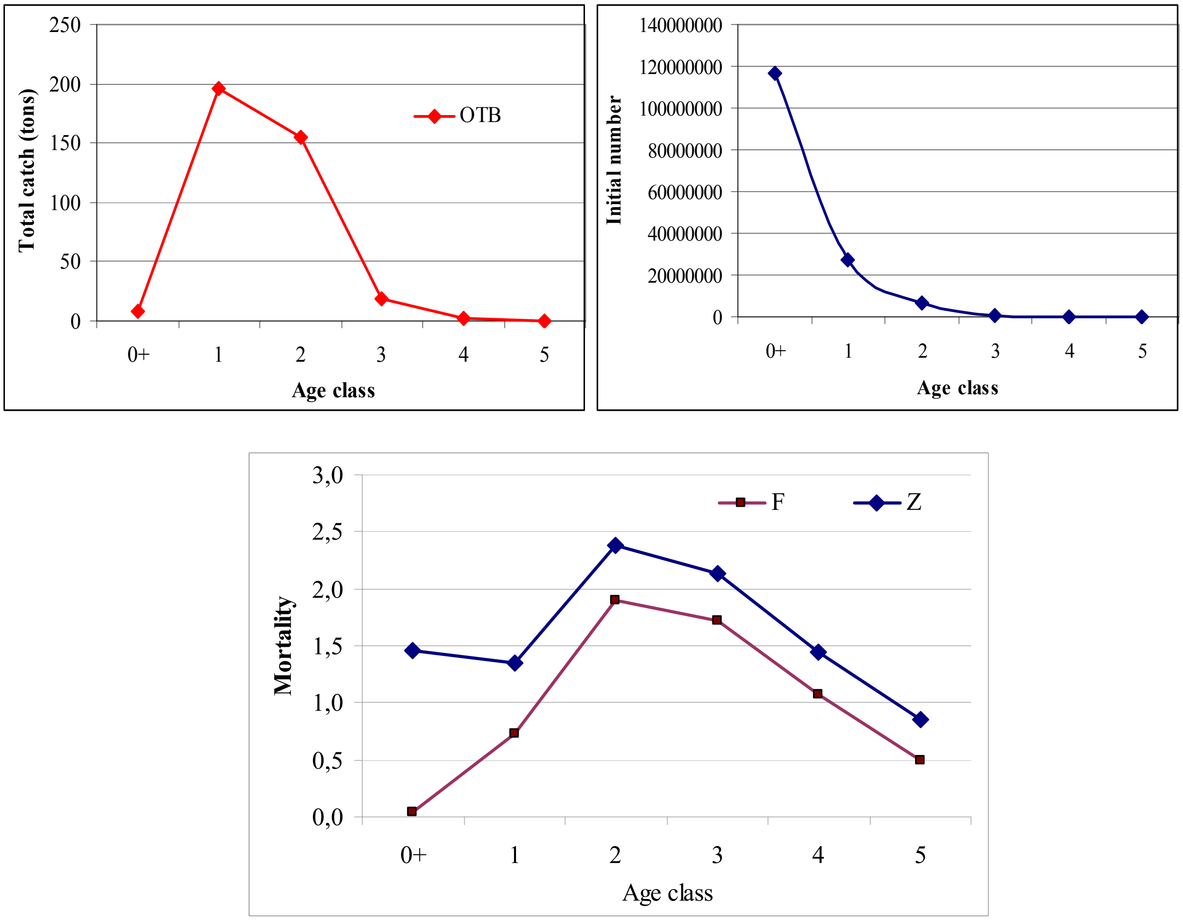


Fig. 6.6.4.1.3.1 LCA outputs: catch in biomass, initial number and fishing mortality at age of *S. mantis* in the GSA 09.

6.6.5 Long term prediction

6.6.5.1 Justification

Yield per recruit analysis was conducted based on the exploitation pattern resulting from the VIT model and population parameters.

The Y/R analysis allowed to estimate the relative yields and surviving fraction of the parental biomass and to produce an estimate of $F_{0.1}$ which can be considered a proxy of F_{MSY}.

The Yield per Recruit (YPR) routine, included in the stock assessment toolbox of NOAA was used. It is based on the Thompson-Bell model for estimating the expected lifetime yield and biomass from a cohort subjected to varying levels of fishing mortality.

The present version incorporates estimates of life-history parameters such as mean age, mean generation time, reproductive value, expected number of spawning specimens, reproductive output from first-, second- and multiple time spawners.

6.6.5.2 Input parameters

The following parameters were used to estimate $F_{0.1}$ through YPR software.

Tab. 6.6.5.2.1 Input to long term forecast.

L∞ = 41.0 mm CL
K = 0.50
t_0 =
a = 0.099
b = 1.737
M = 0.6 CV=0.1
L_{50} = 20 mm, CV=0.05
Spawning season: January-June
Fishing season: January-December

6.6.5.3 Results

Tab. 6.6.5.3.1 shows the reference fishing mortality (Fref), along with the reference points $F_{0.1}$ and the F_{max}. Fig. 6.6.5.3.1 shows the results of the yield per recruit analysis and the Y/R and SSB/R.

Tab. 1.1.5.3.1 Reference fishing mortality (F_{refe}) and the referent points $F_{0.1}$ and the F_{max}.

	Y/R	SSB/R
$F_{0.1}$ = 0.64	18.2	52.1
F_{max} = 1.02	19.2	35.9
F current = 1.35	18.0	31.1

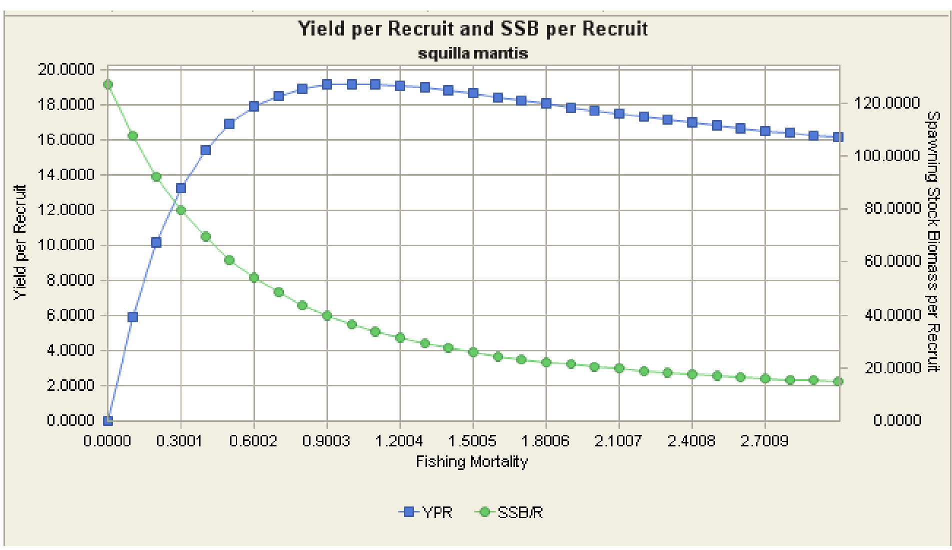


Fig. 6.6.5.3.1 Results of the yield per recruit analysis showing the Y/R and SSB/R.

6.6.6 Data quality

No specific comments were raised.

6.6.7 Scientific advice

6.6.7.1 Short term considerations

6.6.7.1.1 State of the stock size

EWG 11-05 is unable to fully evaluate the status of the stock size as no precautionary reference point is defined. The analyses performed give a SSB estimation of 368 tons in 2009. The Medits survey indicate recent fluctuations without a clear trend in stock abundance.

6.6.7.1.2 State of recruitment

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment. The analyses performed give an estimation of 117×10^6 recruits in 2009.

6.6.7.1.3 State of exploitation

EWG 11-05 proposes $F_{0.1} \leq 0.64$ as limit management reference point consistent with high long term yields (F_{MSY} proxy).

The current F=1.35 estimated for 2009 is above the Y/R $F_{0.1}$ reference point (0.64), which indicates that mantis shrimp in GSA 09 is subject to overexploitation.

EWG 11-05 recommends to reduce fishing mortality towards the proposed reference point $F_{0.1}$. This can be done by reducing fishing effort of the relevant fleets taking into account mixed-fisheries effects. Catch forecasts consistent with the adopted measures shall be estimated.

EWG 11-05 emphasizes that this is the first attempt to evaluate the exploitation state of the species and, therefore, it is necessary to analyze a longer data series in order to confirm the results obtained for 2009.

6.7 Stock assessment of striped red mullet in GSA 09

6.7.1 Stock identification and biological features

6.7.1.1 Stock Identification

Striped red mullet (*Mullus surmuletus*) is a demersal species concentrated on the continental shelf. Even though the species can be found at depths over 250 m, it is mainly concentrated in the depth range 0-150 m. Although the species is present on muddy/sandy bottoms, it prefers heterogeneous substrates characterized by alternation of sand, rocks, coralligenous and shells. In the coastal area the species is often associated to *Posidonia oceanica* beds.

Reproduction occurs from May to June and the recruits, finished their pelagic phase at a size of 6,5 cm of total length, massively concentrate near shore. Then, the specimens tend to move to deeper waters increasing the size.

Due to a lack of information about the stock identification of striped mullet population in the western Mediterranean, this stock was assumed to be confined within the GSA 09 boundaries. As a matter of fact, there is not any available definition of unit stocks neither based on genetics, bio-chemistry, fishery-based nor on any alternative method based on somatic features. Under a management point of view, in the frame of GFCM, it has been decided, when the lack of any evidence does not allow suggesting an alternative hypothesis, that inside each one of the GSAs boundaries inhabits a single, homogeneous striped red mullet stock that behaves as a single well-mixed and self-perpetuating population.

The hypothesis of a single stock of striped red mullet in GSA9, which includes waters belonging to 2 seas (Ligurian and Tyrrhenian) separated by the Elba Island and fleets that do not show any spatial overlapping is almost unlikely.

6.7.1.2 Growth

The growth of striped red mullet has been studied in the GSA 09 using otolith lectures. The following sets of Von Bertalanffy growth parameters were estimated: Females: $L\infty = 32.0$, $K=0.44$, $t0=-0.80$; Males: $L\infty = 28.0$, $K=0.44$, $t0=-0.90$. The life cycle is of 8-9 years. As for the other species of *Mullus* genus, females of striped red mullet attain larger size than males (40 and 30 cm TL, respectively). The growth rates by age seem to be quite similar between the two sexes.

The diet of striped red mullet shows clear differences according to individual size and season. It is mainly made up of crustaceans, especially decapods and amphipods, but also polichaeta and bivalve molluscs are other frequent preys.

6.7.1.3 Maturity

No information was documented during EWG-05-11.

6.7.2 Fisheries

6.7.2.1 General description of fisheries

The species is exploited by different types of gears. The annual landing for 2009 was due for 30% to bottom trawl (75 tons), for 31% to Gillnet (76 tons) and for 39% to trammel net (96 tons).
About 200 bottom trawlers exploit this resource all year round in the coastal area, some of them using devices to exploit hard bottoms where the species is more abundant. Striped red mullet is caught as a part of a species mix that constitutes the target of the trawlers operating near shore. The main associated species caught in GSA9 are *Squilla mantis*, *Sepia officinalis*, *Trigla lucerna*, *Merluccius merluccius*, *Mullus barbatus*, *Z. faber*. The length at first capture of striped red mullet is about 10 cm. Trawl catch is mainly composed by age 0+ individuals while the older age classes are poorly represented in the catch.

As concerns artisanal fisheries, *M. Surmuletus* is caught by gillnet and trammel net. In some period of the year (end of spring-summer), the species represents the target of the artisanal fishery. In particular, part of the fleet uses a small mesh size trammel net to catch it on rocky bottoms near the shore. The catch is mainly composed by age 0+ and 1 individuals.

6.7.2.2 Management regulations applicable in 2010 and 2011

- Minimum landing sizes: EC regulation 1967/2006: 11 cm TL for striped red mullet.
- Fishing closure for trawling: 30-45 days in late summer (not every year have been enforced)
- Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets have been replaced with a cod end with 40 mm (stretched) square meshes or a cod end with 50 mm (stretched) diamond meshes.
- Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast. However, towed gears are always forbidden inside 1.5 miles from the coast with the exception of some areas of the Ligurian Sea that have benefited from the derogation according by the EC Regulation 1967/2006 for the Mediterranean Sea.
- Two small No Take Zones ("Zone di Tutela Biologica", ZTB) are present inside the GSA 09; one off the Giglio Island (50 km^2, northern Tyrrhenian Sea) another off Gaeta, (125 km^2, central Tyrrhenian Sea). Bottom fishing was not allowed in the two ZTB. A recent regulation of the Italian Ministry of Agricultural, Food and Forestry Policies has established that fishing activity can be carried out in these two areas from July 1st to December 31st.

6.7.2.3 Catches

6.7.2.3.1 Landings

The landing showed a clear decreasing trend in the period 2004-2009 (Fig. 6.7.2.3.1.1 and Tab. 6.7.2.3.1.1), with maximum value in 2005 (404 tons) and minimum in 2008 (224 tons). It is difficult to correlate this decline with the reduction in fishing effort as it is not possible to quantify the real effort exerted by the fleet on this resource. However, the LPUEs calculated on the entire fleet show considerable fluctuations with a decreasing trend, particularly evident for the gillnet (Fig. 6.7.2.3.1.2).

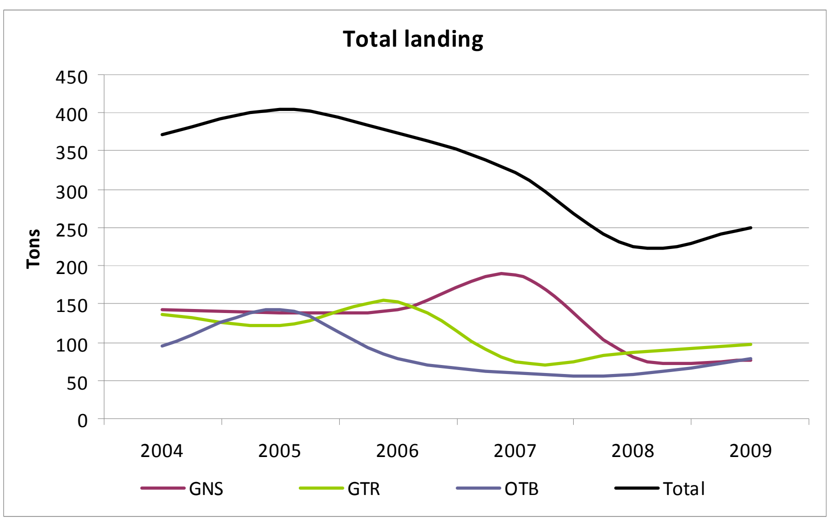
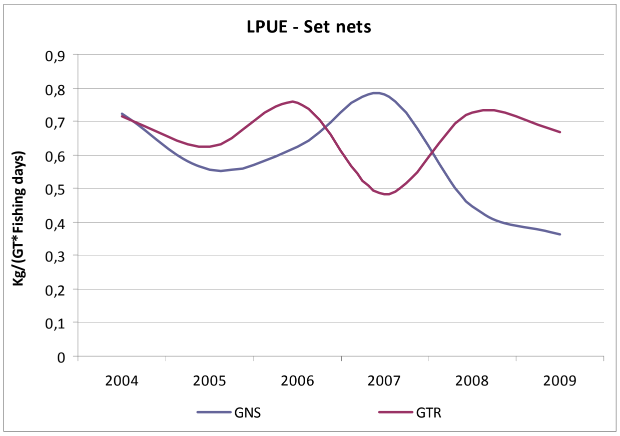


Fig. 6.7.2.3.1.1 Landings (in tons) from the trawl and small-scale fleets in the GSA 09 in the period 2004-2009 (official 2010 DCF data call). GNS: gillnets; GTR: trammel net; OTB: demersal trawling.

Tab. 6.7.2.3.1.1 Landings (in tons) of striped red mullet as reported through the official 2010 DCF data call.

	2004	2005	2006	2007	2008	2009
Otter trawl	94	143	78	60	58	78
Gillnet	142	139	143	188	80	76
Trammel net	136	122	152	74	86	96
Total	372	404	373	322	224	250



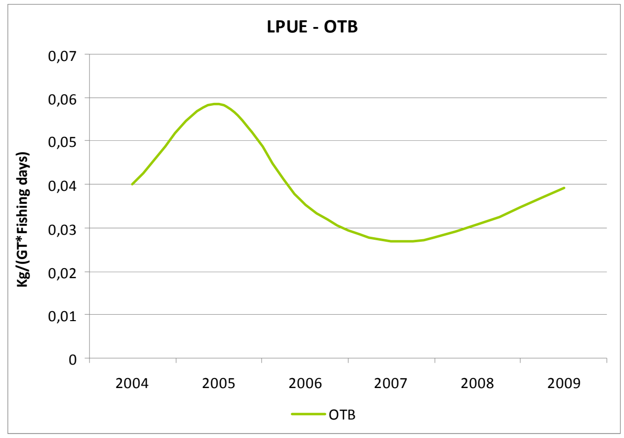


Fig. 6.7.2.3.1.2 Landing per Unit of Effort (LPUE) for set nets (left) and trawling (right) in the GSA 09 for the period 2004-2009 (official 2010 DCF data call). GNS: gillnets; GTR: trammel net; OTB: demersal trawling.

6.7.2.3.2 Discards

According to the data collected in 2009 in the framework of DCF, the discard of striped red mullet from trawling is negligible (0.8 tons). This fraction is composed by specimens under the minimum landing size. No information is available about the discard of set nets for the species.

6.7.2.3.3 Fishing effort

The fishing capacity of the GSA 09 has shown in these last 10 years a progressive decrease; from 1996 to 2007. Fishing effort (GT*fishing days) performed by the GSA 09 trawlers fishing for demersal species decreased from about 2,342,000 in 2004 to about 1,986,000; a decreasing trend has been detected also for trammel net, from 190,000 in 2004 to 143,000 in 2009, while gillnet showed a slightly increase from 197,000 in 2004 to 210,000 in 2009 (Fig. 6.7.2.3.3.1).

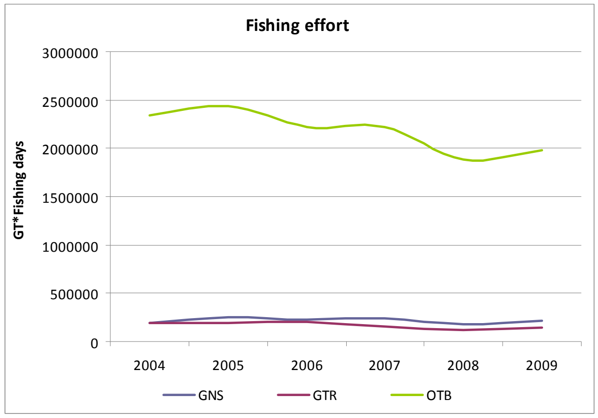


Fig. 6.7.2.3.3.1 Fishing effort (GT* fishing days) for the different type of gears in the GSA 09 during 2004-2009.

6.7.3 Scientific surveys

6.7.3.1 MEDITS

6.7.3.1.1 Methods

Based on the DCR data call, abundance and biomass indices were recalculated. In GSA01 the following number of hauls was reported per depth stratum (Tab. 6.7.3.1.1.1).

Tab. 6.7.3.1.1.1. Number of hauls per year and depth stratum in GSA09, 1994-2009.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
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GSA09_050-100	19	20	18	19	18	19	20	20	15	15	15	14	16	16	13	14
GSA09_100-200	35	35	36	35	35	35	34	34	26	27	26	27	25	26	28	27
GSA09_200-500	32	33	33	36	32	36	37	35	27	27	27	28	29	33	30	28
GSA09_500-800	31	30	31	28	30	28	27	29	24	22	21	20	20	17	18	20

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Catches by haul were standardized to 60 minutes hauling duration. The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$
$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$
Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean
The variation of the stratified mean is then expressed as the 95 % confidence interval:
Confidence interval = $Yst \pm t$(student distribution) $* V(Yst) / n$

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA.

6.7.3.1.2 Trends in abundance and biomass

Fishery independent information regarding the state of striped red mullet in GSA09 was derived from the international survey MEDITS. Figure 6.7.3.1.2.1 displays the estimated trend in abundance and biomass in depth stratum 0-200 m. The estimated abundance and biomass indices do not reveal a clear trend. However, the recent estimates indicate a low stock size in 2008 and 2009.

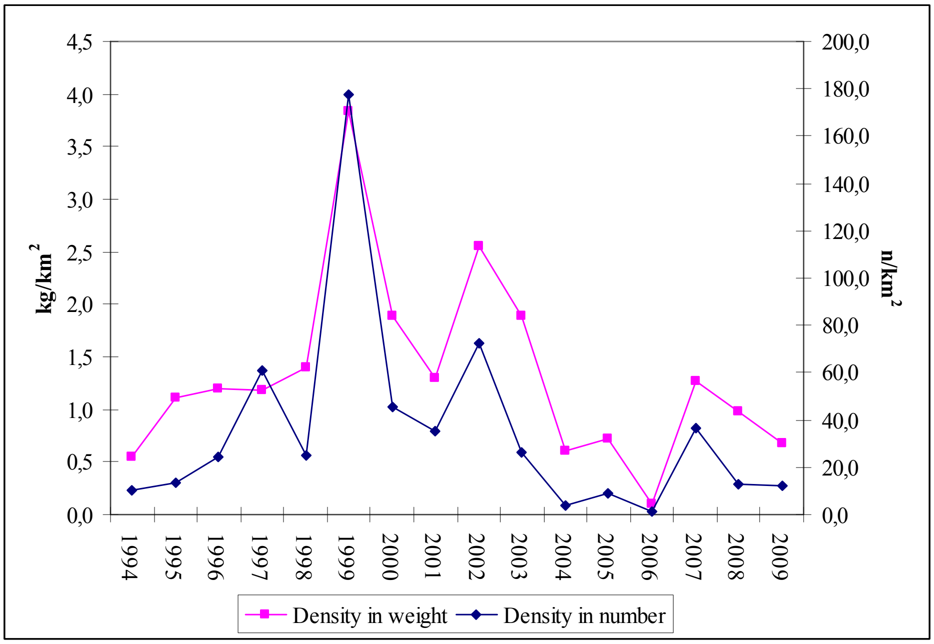


Fig. 6.7.3.1.2.1 Trends of the density indices estimated through the MEDITS survey. Based on the DCR data call, abundance and biomass indices were recalculated.

6.7.3.1.3 Geographical distribution patterns

No information was documented during EWG-05-11.

6.7.3.1.4 Trends in abundance by length or age

No information was been documented.

6.7.3.1.5 Trends in growth

No information was been documented.

6.7.3.1.6 Trends in maturity

No information was been documented.

6.7.4 Assessments of historic stock parameters

6.7.4.1 Method 1: Length Cohort Analysis

6.7.4.1.1 Justification

This is the first assessment of striped red mullet in the GSA 09. A LCA was performed aimed at the estimation of a vector of F at size, using data on total annual catches by size, including discard for trawling. Considering that only data for 2009 were available, it was not possible to perform a formal VPA. The software used to carry out the analyses was VIT.

6.7.4.1.2 Input parameters

Catch of red striped mullet are from three fisheries: bottom trawlers targeting a coastal demersal assemblage and artisanal fisheries using trammel nets and gillnets.

The length frequency distribution and the age frequency distribution of the three gears landing for sexes combined are shown in Fig. 6.7.4.1.2.1 and in Fig. 6.7.4.1.2.2, respectively.

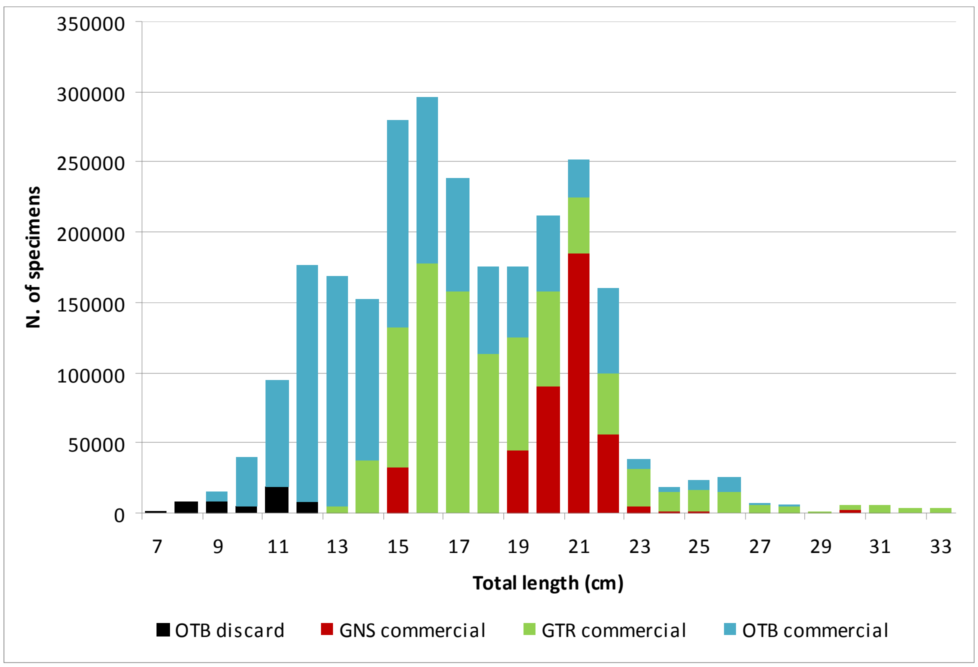


Fig. 6.7.4.1.2.1 Size frequency distributions of trawl fleet (OTB), gillnet (GNS) and trammel net (GTR) for the year 2009.

The exploited size range is wide, from 8 to 33 cm TL, corresponding to specimens between 0+ and 7 age classes. The trawl landing is mainly composed by specimens of size comprised between 11 and 22 cm TL, most of which belonging to 0+ and 1 age classes; discard from trawling is quite negligible and composed by specimens under the minimum legal size. Gillnet landing shows a narrow size range (19-22 cm TL) corresponding to age 1 individuals. Trammel net landing is characterised by a wide size range, although the majority of the specimens are comprised between 14 and 23 cm TL (0+ and 1 age classes).

Tab. 6.7.4.1.2.1 reports the number of specimens by age class and "metier" landed in the GSA 09 during 2009.

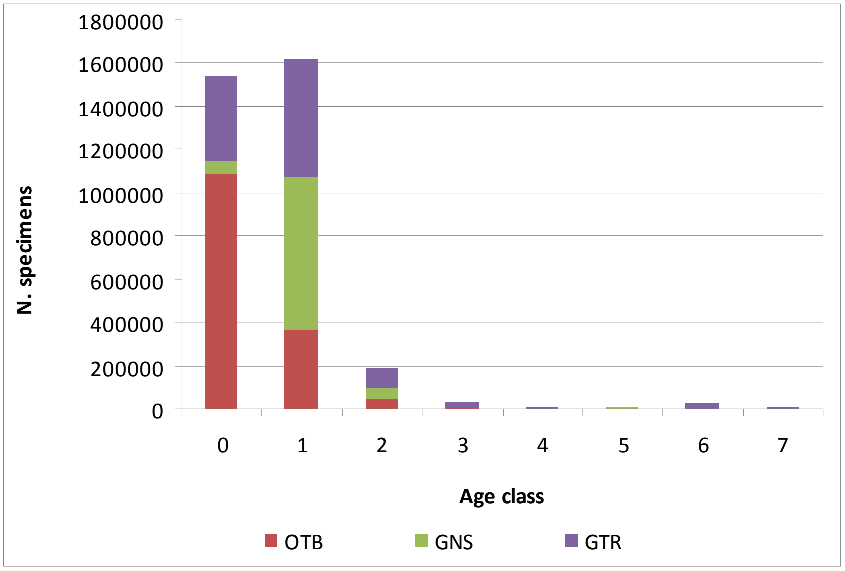


Fig. 6.7.4.1.2.2 Landings numbers at age for 2009.

Tab. 6.7.4.1.2.1 Landing numbers at age (in thousands), 2009.

Age class	Total catch	OTB	GNS	GTR
0+	1537	1084	65	388
1	1617	370	704	543
2	188	51	51	86
3	34	11	0	23
4	6	1	1	4
5	12	0	5	8
6	21	0	0	21
7	7	0	0	7
Total	3422	1517	825	1080

The following set of parameters was used to perform the LCA:

Growth parameters (Von Bertalanffy)
$L\infty$ = 32.0 (cm, total length, TL)
K = 0.43
to = -0.70
L*W
a = 0.01
b = 3.103
Natural mortality
M vector Age_1=0.49, Age_2=0.26, Age_3=0.22, Age_4=0.20, Age_5=0.19, Age_6=0.18, Age_7=0.18, Age_8=0.17
Length at maturity (L_{50})
L_{50} = 11.5 cm TL
Proportion of matures
Age_1=0.65, Age_2=1.00, Age_3=1.00, Age_4=1.00, Age_5=1.00, Age_6=1.00, Age_7=1.00, Age_8=1.00

The vector of natural mortality M was estimated using the software Prodbiom.

6.7.4.1.3 Results

VIT results regarding the pattern of catch reconstruction by age, year and “metier”, and the total and fishing mortality by age and “métier”, are showed in Fig. 6.7.4.1.3.1. The total catch in biomass is mainly based on the fish of age class 1, particularly abundant in the catches of trammel net and gillnet. Age class 0+ is important in the catches of trawling. Ages older than 2 are instead the major target of trammel net. Fishing mortality peaked for specimens of age classes 1 and 2.

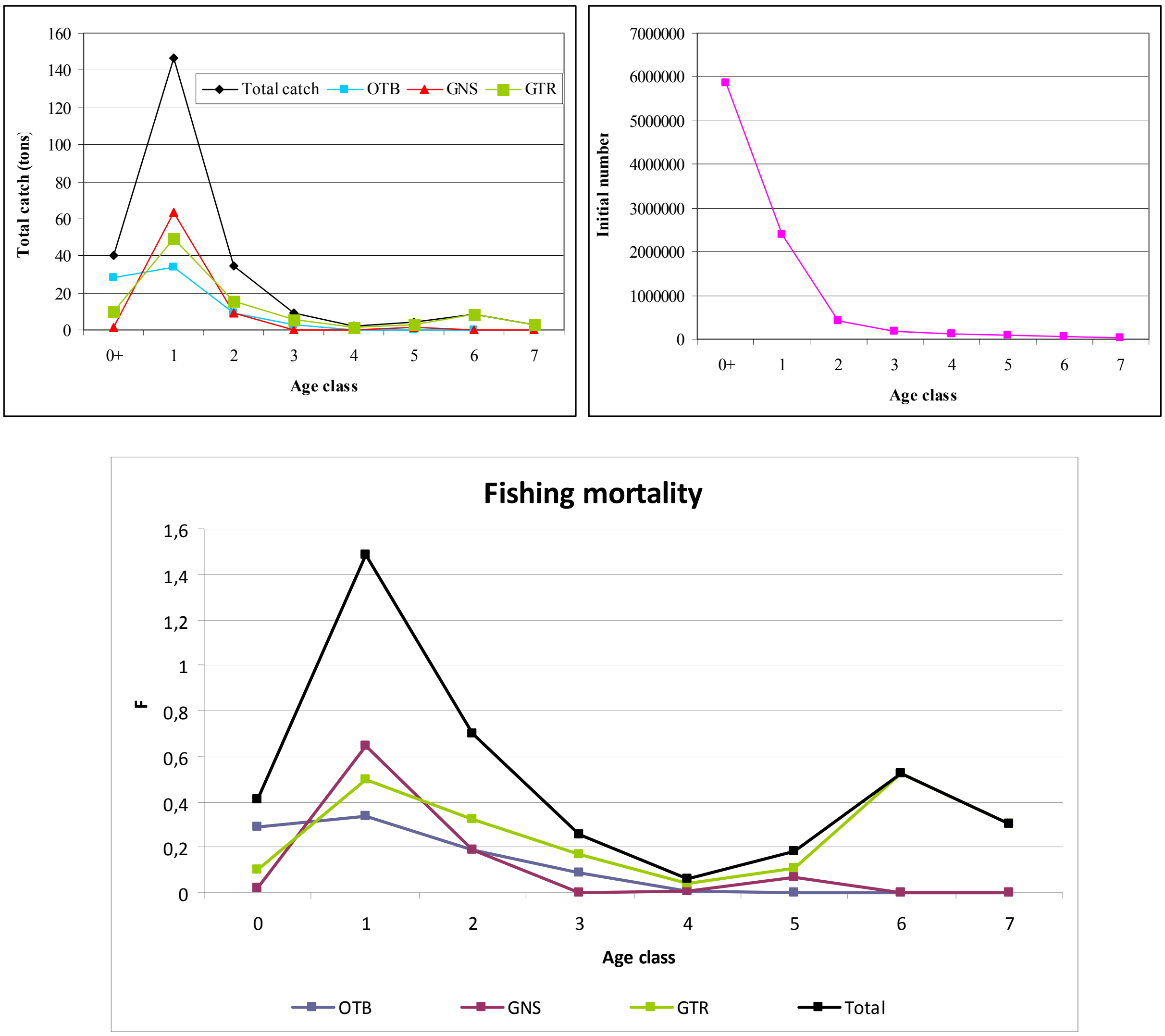


Fig. 6.7.4.1.3.1 LCA outputs: catch in biomass, initial number and fishing mortality at age of *M. barbatus* in the GSA 09.

6.7.5 Long term prediction

6.7.5.1 Justification

Yield per recruit analysis was conducted based on the exploitation pattern resulting from the VIT model and population parameters.
The Y/R analysis allowed to estimate the relative yields and surviving fraction of the parental biomass and to produce an estimate of $F_{0.1}$ which can be considered a proxy of F_{MSY}.
The Yield per Recruit (YPR) routine, included in the stock assessment toolbox of NOAA was used. It is based on the Thompson-Bell model for estimating the expected lifetime yield and biomass from a cohort subjected to varying levels of fishing mortality.
The present version incorporates estimates of life-history parameters such as mean age, mean generation time, reproductive value, expected number of spawning specimens, reproductive output from first-, second- and multiple time spawners.

6.7.5.2 Input parameters

The following parameters were used to estimate $F_{0.1}$ through YPR software.

Tab. 6.7.5.2.1 Input to long term forecast.

$L\infty$ = 32.0 cm TL
K = 0.43
t_0 = -0.70
a = 0.01
b = 3.103
M = 0.4 CV=0.1
L_{50} = 11 cm, CV=0.05
Spawning season: May-June
Fishing season: January-December

6.7.5.3 Results

Tab. 6.7.5.3.1 shows the reference fishing mortality (Fref), along with the reference points $F_{0.1}$ and the F_{max}. The value of F current was obtained averaging the estimated F values of age classes 0+, 1, 2 and 3. Fig. 6.7.5.3.1 shows the results of the yield per recruit analysis and the Y/R and SSB/R.

Tab. 1.1.5.3.1 Reference fishing mortality (F_{refe}) and the referent points $F_{0.1}$ and the F_{max}.

	Y/R	SSB/R	B/R
$F_{0.1}$ = 0.31	45.4	183.5	190.3
F_{max} = 0.44	46.9	122.7	129.2
F current = 0,71	43.5	56.8	62.7

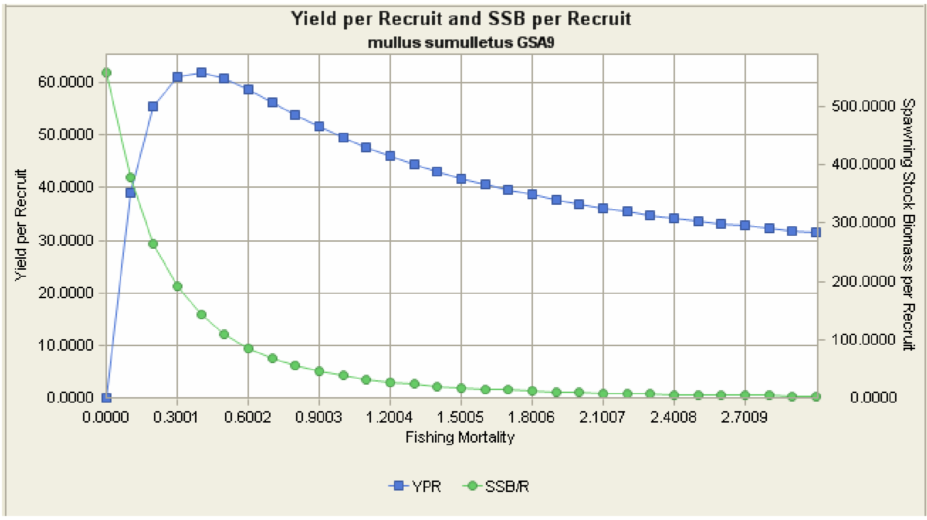


Fig. 6.7.5.3.1 Results of the yield per recruit analysis showing the Y/R and SSB/R.

6.7.6 *Data quality*

No comment provided.

6.7.7 *Scientific advice*

6.7.7.1 Short term considerations

6.7.7.1.1 State of the stock size

EWG 11-05 is unable to fully evaluate the status of the stock size as no precautionary reference point is defined. The analyses performed give a SSB estimation of 335 tons in 2009. The Medits survey indicate recent fluctuations without a clear trend in stock abundance. However, the recent estimates indicate a low stock size in 2008 and 2009.

6.7.7.1.2 State of recruitment

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment. The analyses performed give an estimation of 5.8×10^6 recruits in 2009.

6.7.7.1.3 State of exploitation

EWG 11-05 proposes $F_{0.1} \leq 0.31$ as limit management reference point consistent with high long term yields (F_{MSY} proxy).

The current F=0.71 in 2009 is above the Y/R $F_{0.1}$ reference point (0.31), which indicates that striped red mullet in GSA 09 is subject to overfishing.

SGMED-11-01 recommends to reduce fishing mortality towards the proposed reference point $F_{0.1}$. This can be done by reducing fishing effort of the relevant fleets and acting on selectivity as striped red mullet in GSA 09 is caught in large quantities by set nets targeting the species. Catch forecasts consistent with the adopted measures shall be estimated.

As striped red mullet is mainly caught by different gears and in mixed fisheries, the measures adopted to reduce fishing mortality require multi-annual management plans.

On the other hand, this is the first attempt to evaluate the exploitation state of the species and, therefore, it is necessary to analyze a longer data series in order to confirm the results obtained for 2009.

6.8 Stock assessment of blackmouth catshark in GSA 09

6.8.1 Stock identification and biological features

6.8.1.1 Stock Identification

There is not any available definition of unit stocks neither based on genetics, bio-chemistry, fishery-based nor on any alternative method based on somatic features. Under a management point of view, in the frame of GFCM, it has been decided, when the lack of any evidence does not allow suggesting an alternative hypothesis, that inside each one of the GSAs boundaries inhabits a single, homogeneous stock that behaves as a single well-mixed and self-perpetuating population. The same assumption apply for SGMED.

The inability to account for spatial structure reduces flexibility and can lead to uncertainty in the definition of the status of the stocks, due to the possibility of local depletions and to a worse utilization of the potential productivity of the resources.

6.8.1.2 Growth

The species is slow growing. The parameters reported as follows may be considered suitable for the description of growth performance valid for the whole GSA9.

Common (both sexes combined) growth parameters considered representative for *G. melastomus* in the GSA9 were utilized in the analyses. Such decision is based on the almost equal size at age that the individuals of both sexes can reach.

Von Bertalanffy's growth parameters $L_\infty = 64$; K = 0.15; to = 0 for both sexes

Length/weight relationship a = 0.0025 b = 3.02

M = 0.25

6.8.1.3 Maturity

The species reaches massively the sexual maturity at 6 years old.

The Lm50% and corresponding maturity range (Lm25% - Lm75%) in females and males, respectively is 433 (423-443) and 380 (366-394) mm. Sex ratio is about 1:1.

Tab. 6.8.1.1.2.1 Fecundity at age (max production of number of eggs/year) of *Galeus melastomus* used in the analyses.

Age	Fecundity
0	0
1	0
2	0
3	0
4	0
5	0
6	10
7	12
8	14
9	17
10	20
11	23
12	28
13	33
14	38
15	44

6.8.2 Fisheries

6.8.2.1 General description of fisheries

The blackmouth catshark *Galeus melastomus* is a deep sea species, mainly distributed in the depth range 200-1000 m and has a low commercial value. The species is caught with bottom trawl nets. Only relatively big-sized individuals are landed. It is mainly caught as by-catch in the Norway lobster fishery, by vessels operating within the 250-500m depth range and in Red shrimps fisheries in deeper waters (up to 800m). Other involved species of the Nephrops and Red shrimps fisheries are *Phycis blennoides, Micromesistius potassou, Lepidopus caudatus, Trachurus trachurus, Conger conger, Macrouridae, Etmopterus spinax, Gadiculus argenteus, Parapenaeus longirostris.*

6.8.2.2 Management regulations applicable in 2010 and 2011

Fishing closure for trawling: a 45 days trawling ban was enforced in GSA9 in late summer. The measure was in the past not compulsory and hence adhesion did not covered all the fleets of the GSA. Only since 2008 it is compulsory for all the trawlers in the area and is expected this measure with the same characteristics will be remain in the future.

Minimum landing sizes: not defined minimum legal landed size for blackmouth catshark .

Cod end mesh size of trawl nets of 40 mm (stretched, diamond meshes) has been recently changed by the new adopted cod ends of 40mm with square mesh geometry or alternatively by a net with a cod end of 50 mm stretched diamond meshes. It is not expected a noticeable increase in the size of entering to the fishery of the species with the introduced changes.

6.8.2.3 Catches

6.8.2.3.1 Landings

Annual landings are very low and show a high seasonal variability, with peaks in the 2nd and 3rd trimesters.

Tab. 6.8.2.3.1.1 Landings (kg) in 2009.

Landings in Kgs 2009				
	1st trimester	2nd trimester	3rd trimester	4th trimester
OTB_DES_>	1345.89	2391.08	158.48	892.73
OTB_MDD_>	305.52	1115.37	2848.18	310.64
	1651.41	3506.45	3118.39	1203.37

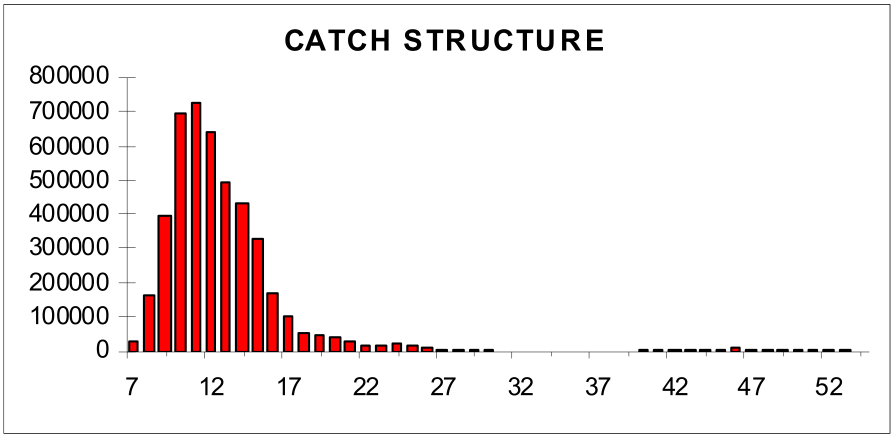


Fig. 6.8.2.3.1.1 Size structure of commercial catches for trawlers year 2009.

6.8.2.3.2 Discards

Percentage and size structure of discards are not well described. In any case, most of the catch in size and in weight is discarded and almost always only big-sized individuals, longer than 40 cm are landed.

6.8.2.3.3 Fishing effort

The effort by fishing technique deployed in GSA 09 is requested in the DCR data calls. A minor decrease is observed for the main gear demersal otter trawl and changes in the importance of the effort from the different gears and segments can be observed. It is however difficult to extract from these figures the real number of vessels that target deep sea resources where *Galeus melastomus* is involved.

In the last 15 years, a general decrease in the number of fishing fleets operating in the GSA9 targeting demersal species was observed. This general reduction did not occurred for the vessels targeting *Nephrops norvegicus* for which an increase in the number has been detected, at least in some ports, following an increasing trend of the abundance of the fishery's target species. The number of vessels targeting the species in question and the changes along the time interval 1990-2009 for the port of Viareggio are shown in the next figure.

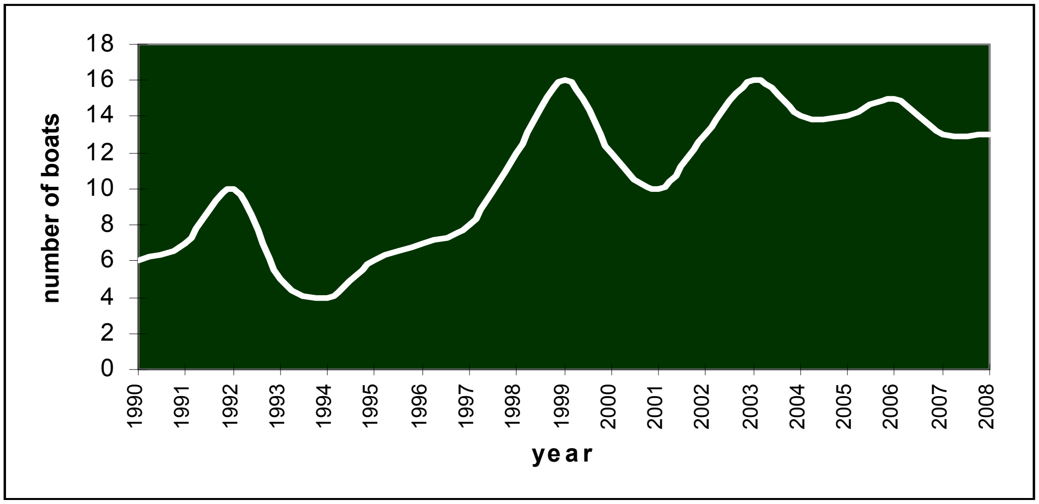


Fig. 6.8.2.3.3.1 Number of vessels targeting deep sea resources in the port of Viareggio (1990-2008).

6.8.3 Scientific surveys

6.8.3.1 MEDITS

6.8.3.1.1 Methods

Based on the DCR data call, abundance and biomass indices were recalculated. In GSA01 the following number of hauls was reported per depth stratum (Tab. 6.8.3.1.1.1).

Tab. 6.8.3.1.1.1. Number of hauls per year and depth stratum in GSA09, 1994-2009.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GSA09_010-050	19	18	18	18	19	18	18	18	13	13	13	14	13	13	13	14
GSA09_050-100	19	20	18	19	18	19	20	20	15	15	15	14	16	16	13	14
GSA09_100-200	35	35	36	35	35	35	34	34	26	27	26	27	25	26	28	27
GSA09_200-500	32	33	33	36	32	36	37	35	27	27	27	28	29	33	30	28
GSA09_500-800	31	30	31	28	30	28	27	29	24	22	21	20	20	17	18	20

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Catches by haul were standardized to 60 minutes hauling duration. The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$
$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$
Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval:
Confidence interval = Yst ± t(student distribution) * V(Yst) / n

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA.

6.8.3.1.2 Trends in abundance and biomass

Fishery independent information regarding the state of striped red mullet in GSA09 was derived from the international survey MEDITS. Figure 6.8.3.1.2.1 displays the estimated trend in stock size in depth strata 200-500 and >500 m, respectively. The estimated abundance and biomass indices do not reveal a clear trend.

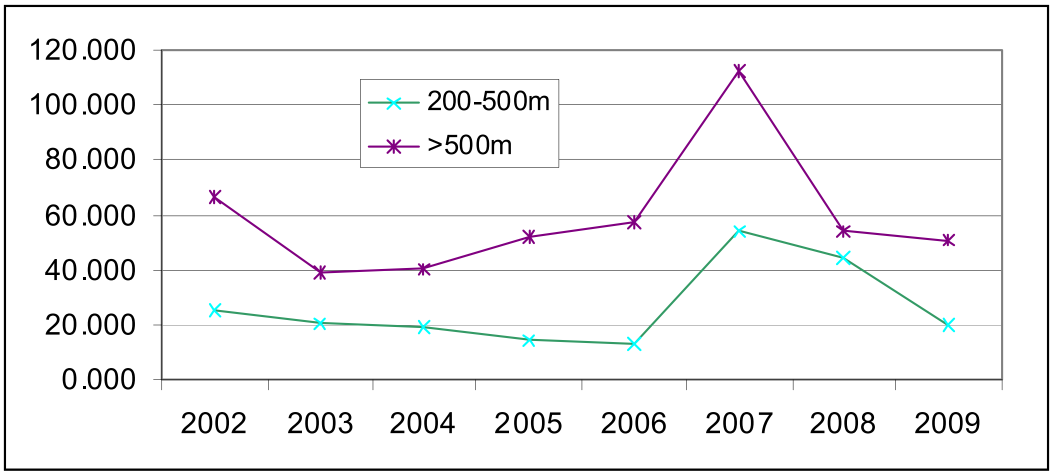
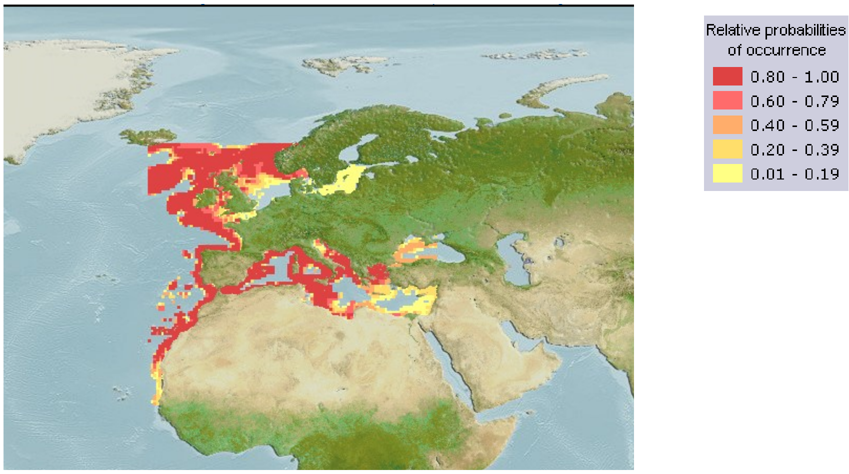


Fig. 6.8.3.1.2.1 Trends of the density indices (kg/km^2) estimated through the MEDITS survey. Based on the DCR data call, abundance and biomass indices were recalculated.

6.8.3.1.3 Geographical distribution patterns

The species is distributed over the eastern Atlantic from Norway to Senegal and in the Mediterranean Sea. It can be found at depths between 100 and 2000m, but is mainly concentrated in the depth range 200-1200m.



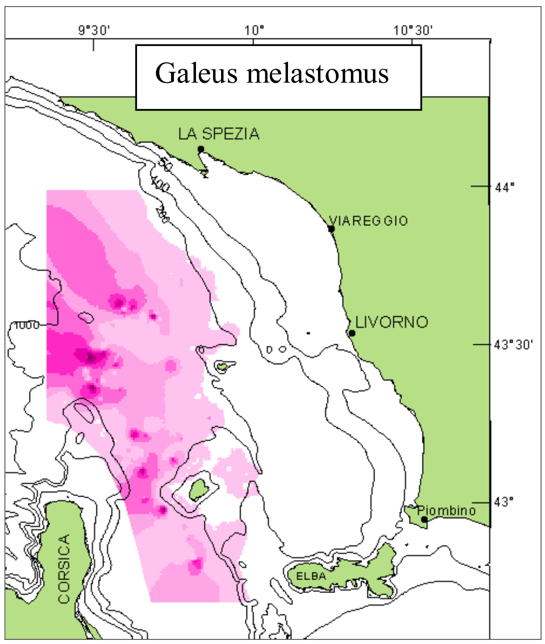


Fig. 6.8.3.1.3.1 Distribution of *Galeus melastomus* in the northern portion of GSA9.

Nursery areas characterized by the presence of young individuals densely concentrated are found in the depth range 200-400m

6.8.3.1.4 Trends in abundance by length or age

No information was been documented.

6.8.3.1.5 Trends in growth

No information was been documented.

6.8.3.1.6 Trends in maturity

No information was been documented.

6.8.4 Assessments of historic stock parameters

6.8.4.1 Method 1: Length cohort analysis LCA

6.8.4.1.1 Justification

A LCA was performed aimed at the estimation of a vector of *F*-at-size, using data on total annual catches by size for the year 2009, including discards. Considering the availability of only one year of data, it was not possible to perform a formal VPA. The size distribution of the catch for the year 2009 was used assuming to be representative of an equilibrium status.

6.8.4.1.2 Input parameters

Official data of blackmouth catshark proceeds from catch data of two fisheries (bottom trawlers targeting deep sea resources and a not well defined category of mixed fishery.

6.8.4.1.3 Results

The analysis suggest a mean *F* of about 0.4. The values of *F* for the bigger ages may be handled with care due to the limited number of individuals included in the analysis. The biggest individuals in general live at deeper waters and are seldom caught.

F vector

F	0	1	2	3	4	5	6	7	8	9
2009	0.9	0.8	0.5	0.15	0.14	0.1	0.2	0.25	0.27	0.2

6.8.5 Long term prediction

6.8.5.1 Method 1: YpR analysis

6.8.5.1.1 Justification

The Y/R analysis allowed to estimate the relative yields and surviving fraction of the parental biomass and to produce an estimate of $F_{0.1}$ which can be considered a proxy of F_{MSY}.

The Yield per Recruit (YPR) routine, included in the stock assessment toolbox of NOAA was used. It is based on the Thompson-Bell model for estimating the expected lifetime yield and biomass from a cohort subjected to varying levels of fishing mortality.

The present version incorporates estimates of life-history parameters such as mean age, mean generation time, reproductive value, expected number of spawnings, reproductive output from first-, second- and multiple time spawners.

6.8.5.1.2 Input parameters

The input parameters (growth parameters, M, Length/weight relationship) are those defined below.

Table 6.8.5.1.2.1. Input parameters to the yield per recruit analysis.

Table not provided by the expert.

6.8.5.1.3 Results

The main results are reported in the following table and figure.

Tab. 6.8.5.1.3.1 Resulting parameters obtained from the YpR analysis.

Reference Point	F	Yield per Recruit	SSB per Recruit	Total Biomass per Recruit	Mean Age	Mean Generation Time	Expected Spawnings
F Zero	0.00000	0.00000	178.19385	414.54311	4.15955	11.40241	0.39369
F-01	0.12420	19.46279	50.31491	188.20181	3.16517	10.96978	0.10494
F-Max	0.17630	20.29523	30.06031	141.73859	2.87871	10.80542	0.06111
F at 40 %MSP	0.08940	17.47643	71.32531	230.89026	3.39404	11.08557	0.15126

Fig. 6.8.5.1.3.1 Resulting parameters obtained from the YpR analysis. Yield/R and SSB/R obtained with the current exploitation pattern. The age-based version of Yield per recruit of the NOAA stock assessment toolbox was used

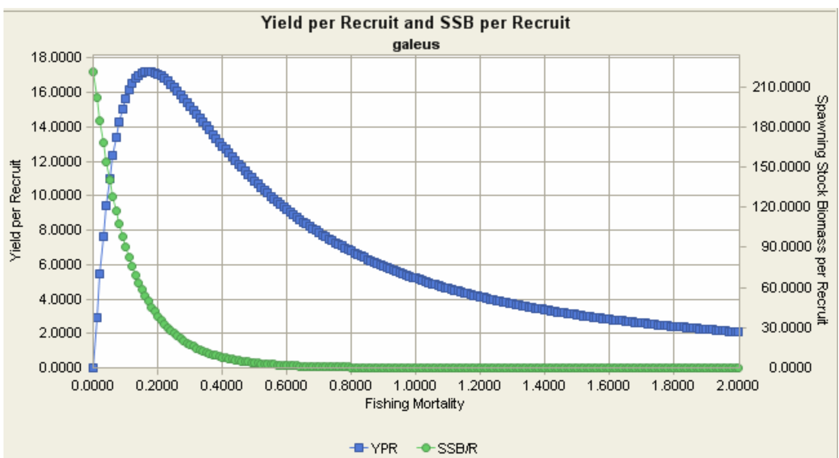


Fig. 6.1.5.3.1.1 YpR analysis for hake in GSA 1.

6.8.5.2 Method 1: Y Demographic analysis

6.8.5.2.1 Justification

A demographic analysis was used for the definition of the status of the stock regarding its capacity of self-renewal.

For many stocks, data required to support traditional analytic stock assessment models do not exist. This occurs in most of the shark populations, where the collection of these data is overlooked. In such situations models that rely primarily on life history parameters can provide some useful information for management. Such models are normally referred to as demographic models. They are the most widely used approach for modelling population dynamics for this group of fishes (Hoenig and Gruber, 1990; Cailliet, 1992; Cortes, 1999, 2002; Cortes and Parsons, 1996; Smith et al, 1998; Simpfendorfer, 1999; Mollet and Cailliet, 2002). The main parameter estimated by demographic analysis is the intrinsic rate of population increase *r*, that measures the potential for growth in a population. Life tables are based on the Euler-Lotka equation, that needs of the definition of the survival at age, fecundity at age (female pups per female), age at maturity, and maximum reproductive age. The life table keeps track of the age-specific mortality and reproductive rates, and allows estimating *r*.

The main information needed regards lifespan, age at maturity, fecundity by age/size and sex ratio. The basic equation is the Euler-Lotka :

$$\sum_{t=0}^{w} l_t \times m_t \times e^{-rt} = 1$$

where l_t is the proportion of animals surviving to the beginning of a given age class, m_t the age specific natality, *w* is the maximum reproductive age, *t*=age and *r* is the intrinsic population growth rate.

It is possible to estimate the finite or annual rate of change (e^r) from the estimated values of *r*.

The net reproductive rate R_0 is the offspring number of an individual female belonging to a certain age $t \geq \alpha$ and can be calculated as

$$R_0 = \sum_{t=\alpha}^{w} l_t \times m_t$$

while the mean generation lenght (*G*) is the average time that occur between the birth of a parent and the birth of their offspring:

$$G = \frac{\sum_{t=\alpha}^{w} l_t \times m_t \times t}{R_0}$$

The doubling time of population size can be calculated as:

$$T_{\times 2} = \frac{\ln(2)}{r}$$

and the stable proportion of each age P_t in the total demographic distribution of the population can be estimated as follows:

$$P_t = \frac{(e^r)^t l_t}{\sum_{t=o}^{w} (e^r)^t l_t}$$

It is also possible to estimate the intrinsic capacity for increase despite of the particular condition of the environment r_m and following the well-known Verlhust-Pearl population growth model as:

$$r_m = \frac{\ln(R_0)}{G}$$

The method assumes that the population is in a steady state situation. It does not include the likely compensatory effects to fishing pressure as reduction in natural mortality, increase in reproductive rates, earlier age of first maturity, etc.

Age specific survival values, that in the former studies using life tables were based only on natural mortality, can be easily modified by including fishing effects by using total mortality rates Z for the estimation of survival.

The software utilised here is self-constructed An Excel spreadsheet allows estimating a reference point *F*c based on fishing mortality. At this rate, for a given size of first capture, replacement should be guaranteed. Isolines can be constructed showing how different combinations of *F* and *tc* may produce similar results as regards the probability of replacement of the population.

A life history table was constructed using the values of fecundity at age. This is a “per-recruit analysis” that allows the checking of the possibility of the population to replace that single recruit. The six columns of the matrix allows calculating r by using a seed value and setting as 1 the summatory of the last column

Surviving individuals at age are calculated as $N_{t+1}= N_t \exp(-M_t)$.

In the case fishing activity is included, the equation is modified as $N_{t+1}= N_t \exp(-(M_t+F_t))$.

The size of first capture can be modified by including or not *F* in the equation up to a certain age.

It is possible to define the value of F_c for the current exploitation pattern by estimating which should be the value of F that correspond to a population growth rate of zero. Moreover, contour plots can be constructed for displaying the values of *r* corresponding to different combinations of *tc* and *F*.

6.8.5.2.2 Input parameters

The input parameters (growth parameters, M, Length/weight relationship) are those defined below.

Table 6.8.5.2.2.1. Input parameters to the yield per recruit analysis.
Table not provided by the expert

6.8.5.2.3 Results

The results of the demographic analysis suggest that the current combination of exploitation pattern and level of *F* do not guarantee sustainability for the stock, that is characterized by a low fecundity and relatively late age of sexual maturity (6 years old).

The generation time *G* corresponding to the weighted mean age of spawners in a not exploited population (Goodyear 1995) was estimated to be 9.8 years assuming a mean M=0.25

Tab. 6.8.5.2.3.1 Life table for Galeus melastomus based on Simpfendorfer (1999).

Simpfendorfer

		gmel							
	Age (t)	proportion surviving (l_t)	Female pups (m_t)	Reproductive rate ($l_{t+1}m_t$)	$l_{t+1}m_t t$	e^{-rt}	$l_{t+1}m_t e^{-rt}$	M=	0.25
								r=	0.288416
	0	1	0	0	0	1	0		
	1	0.778801	0	0	0	0.74945	0		
	2	0.606531	0	0	0	0.561675	0		
	3	0.472367	0	0	0	0.420948	0		
	4	0.367879	0	0	0	0.315479	0		
3.512	5	0.286505	0	0	0	0.236436	0		
	6	0.22313	10	1.810872651	10.8652359	0.177197	0.320881		
	7	0.173774	12	1.659187104	11.6143097	0.1328	0.22034		
	8	0.135335	14	1.520207313	12.1616585	0.099527	0.151302		
	9	0.105399	17	1.392868995	12.535821	0.074591	0.103895		
	10	0.082085	20	1.276197016	12.7619702	0.055902	0.071342		
	11	0.063928	23	1.169297924	12.8622772	0.041896	0.048989		
	12	0.049787	28	1.071353105	12.8562373	0.031399	0.033639		
	13	0.038774	33	0.981612514	12.7609627	0.023532	0.023099		
	14	0.030197	38	0.899388935	12.5914451	0.017636	0.015862		
	15	0.023518	44	0.805888111	12.0883217	0.013217	0.010652		
4.438	16	0.018316	0	0	0	0.009906	0		
			prod.pups	12.58687367	123.098239		1.00	sommatory	
			15.99345	**R_0**	9.77988994	0.258966		MUST BE =1	
0.791			**media**	93*1.15	**G**	**r_m**	2.403292		
juveniles					Generation		**t_{x2}**		0.1568
			0		lenght				

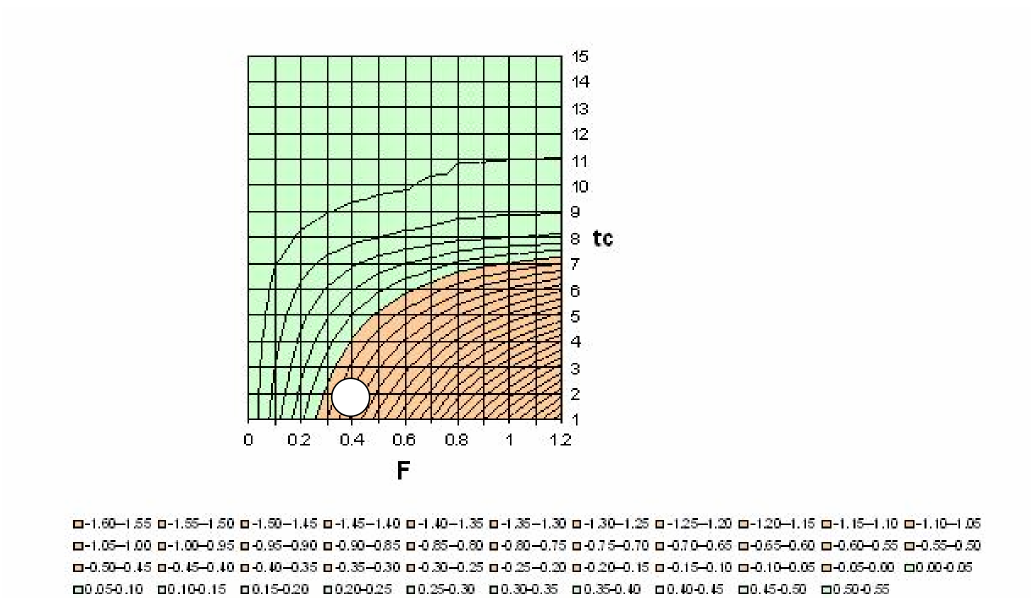


Fig. 6.8.5.2.3.1 Contour plot of intrinsic rate of population increase r as a function of fishing mortality (F) and age at first capture.

The current *F* was estimated as 0.4. Considering the value of $F_{0.1}$ estimated as *F*=0.12 and Fc derived from the demographic analysis for the current exploitation pattern of F=0.25, a reduction of F of about 50% should be necessary in order to drive the stock to a more productive and sustainable status. The achievement of such goals can be facilitated by an increase of the age of entry to the fishery of the species.

6.8.6 *Data quality*

The major shortfall is that fishing effort data have not been provided.

6.8.7 Scientific advice

6.8.7.1 Short term considerations

6.8.7.1.1 State of the stock size

Medits survey indices show a variable pattern of stock size without a clear trend. Since no precautionary level for the stock of blackmouth catshark in GSA 09 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

6.8.7.1.2 State of recruitment

Given the quality of data and results, EWG 11-05 cannot conclude on the state of recruitment.

6.8.7.1.3 State of exploitation

EWG 11-05 proposes $F_{0.1} \leq 0.12$ as limit management reference point consistent with high long term yields (F_{MSY} proxy).

The species is considered overexploited, with consistent diagnosis of the current exploitation status obtained with the 2 used approaches aimed at the definition of precautionary Reference Points ($F_c = 0.25$ and $F_{0.1}=0.12$) which values are much lower than the current estimate of fishing mortality rate of F=0.4. The size of first capture is too low (growth overfishing) and an increase in yield and a more safe situation for the stock as regards the possibility of self-renewal can be expected in the case a reduction of fishing effort do occur and/or more selective gears are used.

6.9 Stock assessment of pink shrimp in GSA 11

6.9.1 Stock identification and biological features

6.9.1.1 Stock Identification

Due to a lack of information about the structure of pink shrimp population in the western Mediterranean, this stock was assumed to be confined within the GSA11 boundaries.

The species show a wide distribution. It is present on muddy and sandy muddy bottoms from 150 to 570 m of depth, with a main occurrence between 200 and 450 meter of depth.

High abundance was located in the shelf break of the central-west coast and on deeper water in the north-western and south-western coast. These are the areas where also the main nurseries are localised together with those of hake.

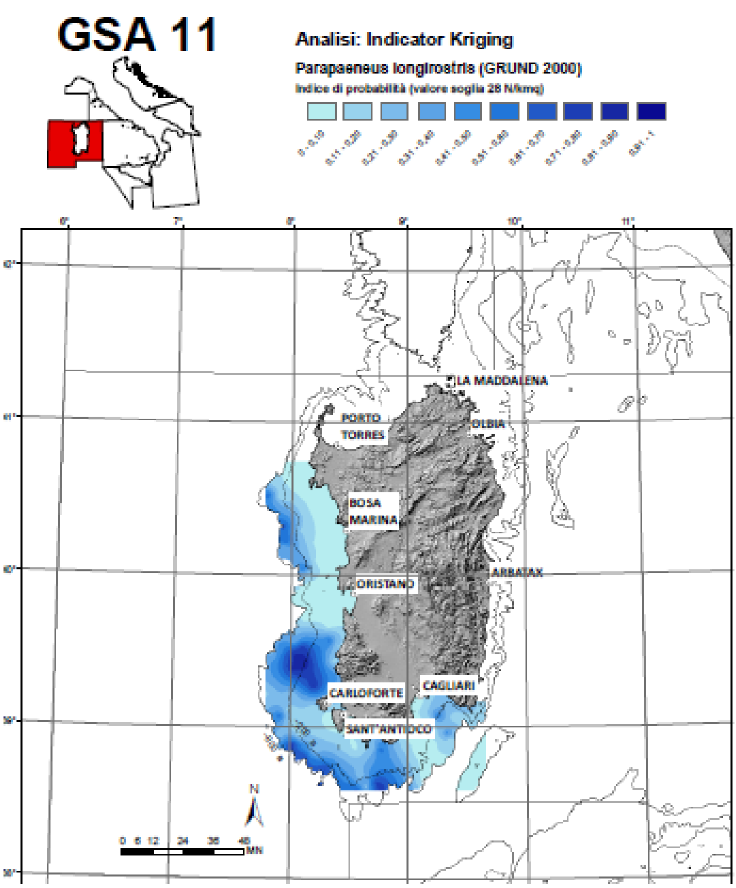


Fig. 6.9.1.1.1 Indicator kriging of *P. longirostris* in the GSA11.

6.9.1.2 Growth

Since the DCR do not provide growth parameters for the GSA 11 those utilized in the central Tyrrhenian Sea where used ($L\infty = 43.5$, $K=0.74$, $t_0=-0.13$).

6.9.1.3 Maturity

The reproductive areas of *P. longirostris* are located in the upper slope where mature females are present all year round. However the main peak is in spring.

The size at onset of sexual maturity is about 24 mm CL.

6.9.2 Fisheries

6.9.2.1 General description of fisheries

The species is one of the most important target species of the fishery carried out on bottoms of the upper slope and it is part of an important fishing assemblage targeted exclusively by trawlers of which as *Nephrops norvegicus*, *Merluccius merluccius*, *Eledone cirrhosa*, *Illex coindetii*, *Todaropsis eblanae*, *Helicolenus dactylopterus, Phycis blennoides, Micromesistius poutassou*, *Lophius* sp. are the most priceless species.

The discard fraction is composed of species such us *Glossanodon leioglossus, Capros aper, Galeus melastomus* and *Raja* sp.

The big trawlers of GSA11 operate all the week from Monday to Saturday, generally coming back daily to the closest port at the coast for few hours early in the morning in order to send all the fish to the market. The mid-sized and small trawlers perform daily fishing trips, before the sunrise until the early morning, staying sometimes two days at sea.

Moreover, due to the distance of the fishing grounds (Murenu et al., 2010) to the main harbors of the western cost and the dominant weather conditions, the fleet targeting *P. longirostris* shows some seasonal variations, with more time spent at sea from mid spring to mid autumn. Some large trawlers move seasonally to different fishing grounds far from the usual ports.

Most of the effort in the GSA is concentrated around the major fishing ports (Cagliari, Alghero, Porto Torres, La Caletta, Sant'antioco, Oristano, Alghero).

The trawl fleet showed remarkable changes from 1994 to 2004, with a general increase in the number of vessels and the replacement of the older ones, low tonnage wooden boats by larger steel boats. Since 2004 for the entire GSA an increase of 85% for boats >70 tons class occurred. A decrease of 20% for the smaller boats (<30 GRT) was also observed.

6.9.2.2 Management regulations applicable in 2010 and 2011

The minimum legal landing size is 20 mm carapace length (EC regulation 1967/2006). The other management regulations are the same described for hake in the GSA11.

6.9.2.3 Catches

6.9.2.3.1 Landings

Total landings of deep water rose shrimps in the latest years (2004-2009), according to DCF data shows a peak of 552 tons in 2005 and in successive years showed a fast decline to a minimum of 42 tons in 2009 (Tab 6.9.2.3.1.1).

Tab. 6.9.2.3.1.1 Annual landings (t) by fishing technique in GSA11 as provided through the official DCF data call 2010.

FT_LVL4	2004	2005	2006	2007	2008	2009
GTR		3.98	2.74			
OTB	232	548	127	79.4	45.8	42.6
total landings	232	552	130	79.4	45.8	42.6

The size structure of the landings, according to the DCR data, shows that in 2009 the most exploited sizes ranged from 22 to37 mm CL with the wider range for female individuals and a short size range for males (22 to 27 mm CL) (Fig. xx); the presence of specimens under the MLS (20 mm CL) is negligible. According to the growth pattern of the species, fishing exploits mainly age classes 1+ to 3+.

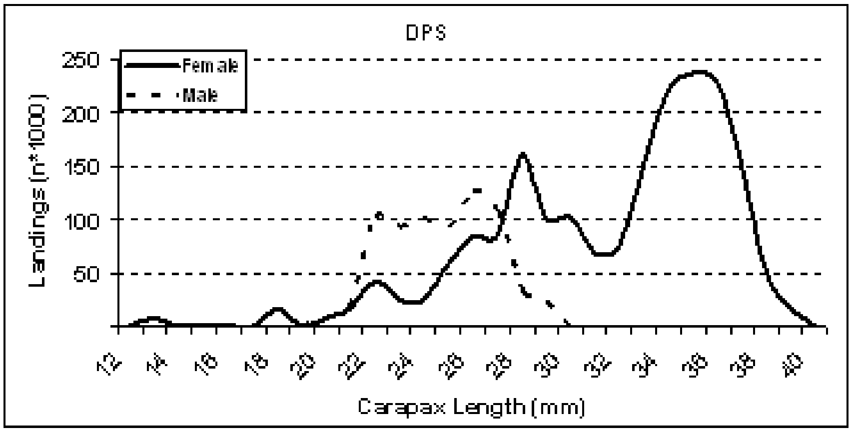


Fig. 6.9.2.3.1 Length frequency distribution of *P. longirostris* by sex landed in the GSA11 in 2009 (DCR data).

6.9.2.3.2 Discards

Pink shrimp are not subject to discarding.

6.9.2.3.3 Fishing effort

The trends in fishing effort by fishing technique reported to SGMED are listed in Tab. 6.9.2.3.3.1 and Tab 6.9.2.3.3.2. After 2006, the effort of the major demersal trawler fleet decreased slightly (Fig. 6.9.2.3.3.1).
In 2011, no values were reported for 2010 by Italian authorities.

Tab. 6.9.2.3.3.1 Trend in fishing effort (kW*days) for Italy in GSA 11 for the major gear types in 2002-2009.

GEARS	2004	2005	2006	2007	2008	2009
Small scal	420270	631677	754571	795134	492056	530948
Trawlers	1535327	1897564	1430360	1469755	1122857	1044475
Total	1955654	2529241	2184931	2264889	1614913	1575423

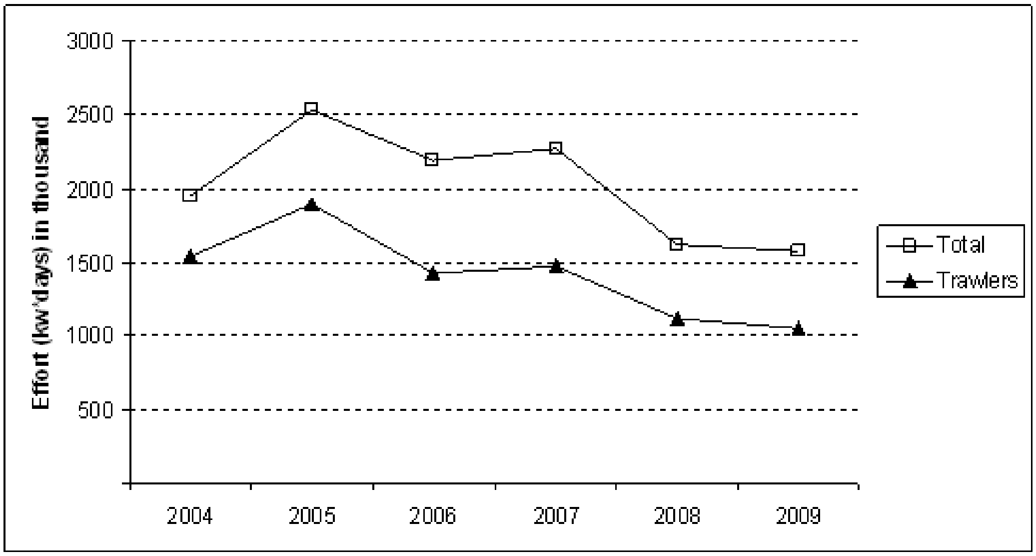


Fig. 6.9.2.3.3.1 Trends in fishing effort (kW*days) for the Italian fleet in GSA 11 for the major gear types in 2004-2009.

Tab. 6.9.2.3.3.2 Trend in fishing effort (kW*days) for Italy in GSA 11 for the major gear types in 2004-2009, as reported through the DCF in 2011.

AREA	GEAR	FISHERY	VESSEL_LENGTH	2004	2005	2006	2007	2008	2009
SA 11	FPO	DEMSP	VL0006				7751	1606	4368
SA 11	FPO	DEMSP	VL0612	2716	1588	44410	76098	46054	52130
SA 11	FPO	DEMSP	VL1218		4670	13678	11266	4821	13957
SA 11	FYK	DEMSP	VL0006				361	390	424
SA 11	FYK	DEMSP	VL0612				222		
SA 11	GNS	DEMSP	VL0006			3022	9714	2449	6982
SA 11	GNS	DEMSP	VL0612	58327	40764	9451	52783	23911	46471
SA 11	GNS	DEMSP	VL1218	716	31294	6450	6914	10463	24978
SA 11	GTR	DEMSP	VL0006			26596	14213	8019	14916
SA 11	GTR	DEMSP	VL0612	319731	338552	334899	227573	162030	192724
SA 11	GTR	DEMSP	VL1218	5176	144214	113369	81455	68753	63542
SA 11	LHP	CEP	VL0006				1504	177	
SA 11	LHP	CEP	VL0612	1035	102	1127	4252	837	123
SA 11	LHP	CEP	VL1218			4504	5019	2624	110
SA 11	LHP	FINF	VL0612			35		1812	2222
SA 11	LHP	FINF	VL1218			609			
SA 11	LLD	LPF	VL0612			6107		474	451
SA 11	LLD	LPF	VL1218	331	26128	21901	194703	119320	70905
SA 11	LLD	LPF	VL2440			56134	7425		
SA 11	LLS	DEMF	VL0006			1140	4309	602	1277
SA 11	LLS	DEMF	VL0612	31502	25781	55072	44598	18778	17272
SA 11	LLS	DEMF	VL1218	736	18584	27703	29512	18893	18055
SA 11	LLS	DEMF	VL1824			2264			
SA 11	LLS	DEMF	VL2440			25810	11987		
SA 11	LTL	LPF	VL0612			290	67	43	41
SA 11	none	-1	VL1218				3408		
SA 11	OTB	DEMSP	VL0612				62		13756
SA 11	OTB	DEMSP	VL1218	164738	161277	184401	15684	160920	156984
SA 11	OTB	DEMSP	VL1824	8736				140874	110236
SA 11	OTB	DEMSP	VL2440				10214	71352	66494
SA 11	OTB	DWSP	VL2440					53859	82114
SA 11	OTB	MDDWSP	VL1218				159997	16243	
SA 11	OTB	MDDWSP	VL1824	435402	610862	415798	410039	115807	138594
SA 11	OTB	MDDWSP	VL2440	926451	1125425	830161	873759	563802	476297
SA 11	PS	SPF	VL1218	57					

6.9.3 Scientific surveys

6.9.3.1 MEDITS

6.9.3.1.1 Methods

Since 1994 the MEDITS trawl surveys have been carried out annualy between May and July (except in 2007).

According to the MEDITS protocol (Relini, 2000; Bertand *et al.*, 2002) a stratified random sampling design with allocation of hauls proportional to depth strata extension (depth strata: 10–50 m, 51–100 m, 101–200 m, 201–500 m, 501–800 m) was adopted. A specific gear (GOC 73, with a 20 mm stretched mesh size in the cod-end) was always used following the instruction stated and reported in Dremière and Fiorentini (1996).

Based on the DCR data call, abundance and biomass indices were recalculated. In GSA 11 the following number of hauls was reported per depth stratum (s. Tab. 6.9.3.1.1.1).

Tab. 6.9.3.1.1.1. Number of hauls per year and depth stratum in GSA 11, 1994-2009.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GSA11_010-050	16	18	21	21	21	20	19	17	20	18	17	17	19	19	17	18
GSA11_050-100	25	21	22	22	20	22	22	24	19	19	18	21	18	20	19	20
GSA11_100-200	20	23	30	31	31	30	29	30	24	24	24	24	24	24	22	24
GSA11_200-500	33	29	29	26	25	27	24	25	20	24	21	20	20	20	21	19
GSA11_500-800	23	16	21	25	25	24	27	26	16	14	15	14	16	17	16	16

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

6.9.3.1.2 Geographical distribution patterns

The spatial distribution of *Parapaeneus longirostris* has been described by modeling the spatial correlation structure of the abundance indices using geostatistical techniques.

The stock is more abundant in the south-western part of the GSA (Sardinian Sea) as shown in Figure 6.9.3.1.2.1.

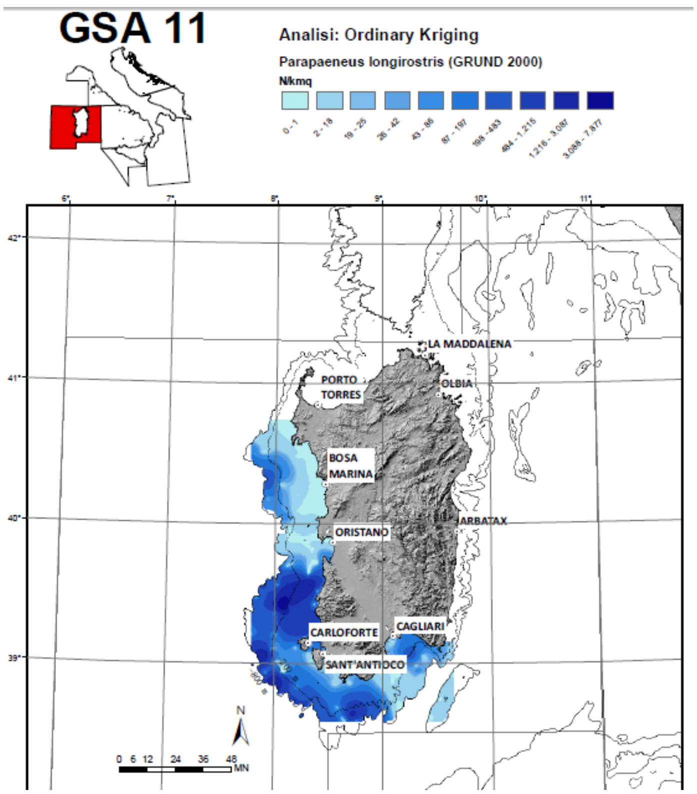


Fig. 6.9.3.1.2.1. *P. longirostris*: MEDITS trends in density and biomass from 1994 to 2009 in GSA11.

6.9.3.1.3 Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSA 11 was derived from the international survey MEDITS. Figure 6.9.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSA 11.

The estimated abundance and biomass indices since 2000 show high variation without any trend.

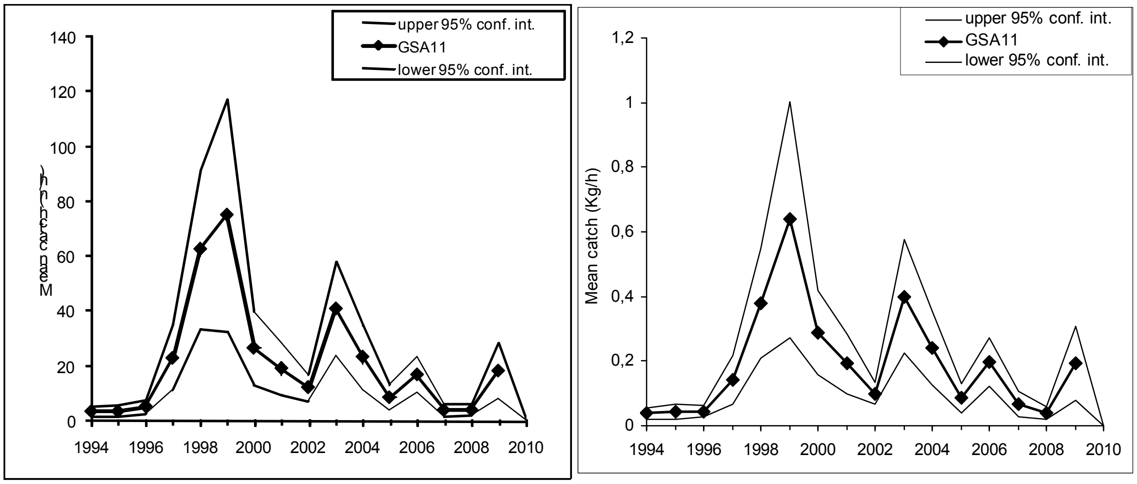


Fig. 6.9.3.1.3.1 Abundance and biomass indices of *P. longirostris* in GSA 11.

From 1994 two trawl surveys are regularly carried out each year: MEDITS, in spring, and GRUND, in autumn, although the MEDITS data only are available to the STECF.

From 1999, when the main peak occurred, a temporal decreasing trend in density and biomass of deep water pink shrimp was observed, even though large fluctuations are present from year to year (Fig. 6.9.3.1.3.2).

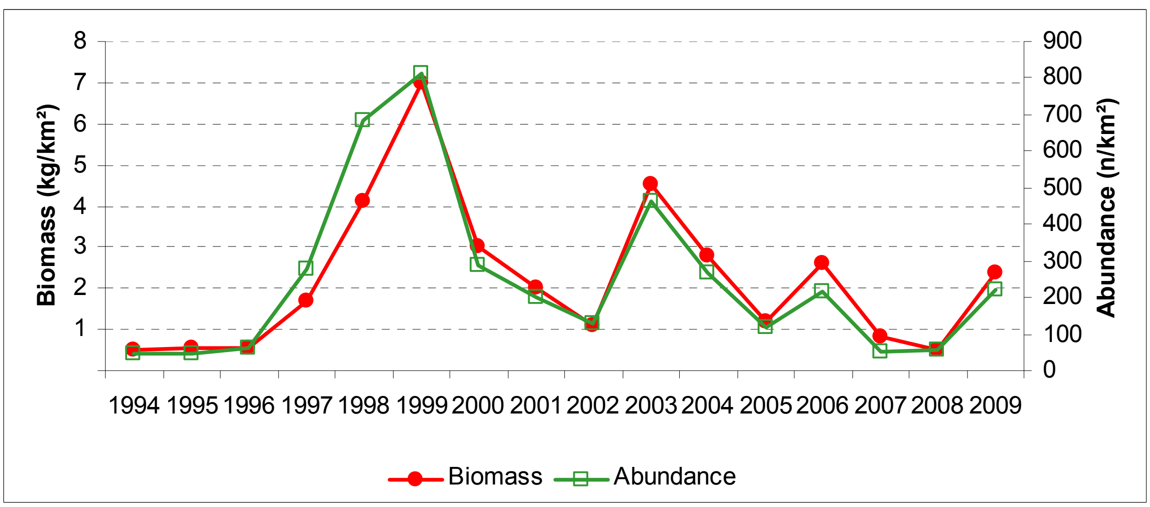


Fig. 6.9.3.1.3.2 *P. longirostris*: MEDITS trends in density and biomass from 1994 to 2009 in GSA11.

6.9.3.1.4 Trends in abundance by length or age

The following Fig. 6.9.3.1.4.1 and 2 display the stratified abundance indices of GSA 11 in 1994-2001 and 2002-2009 respectively.

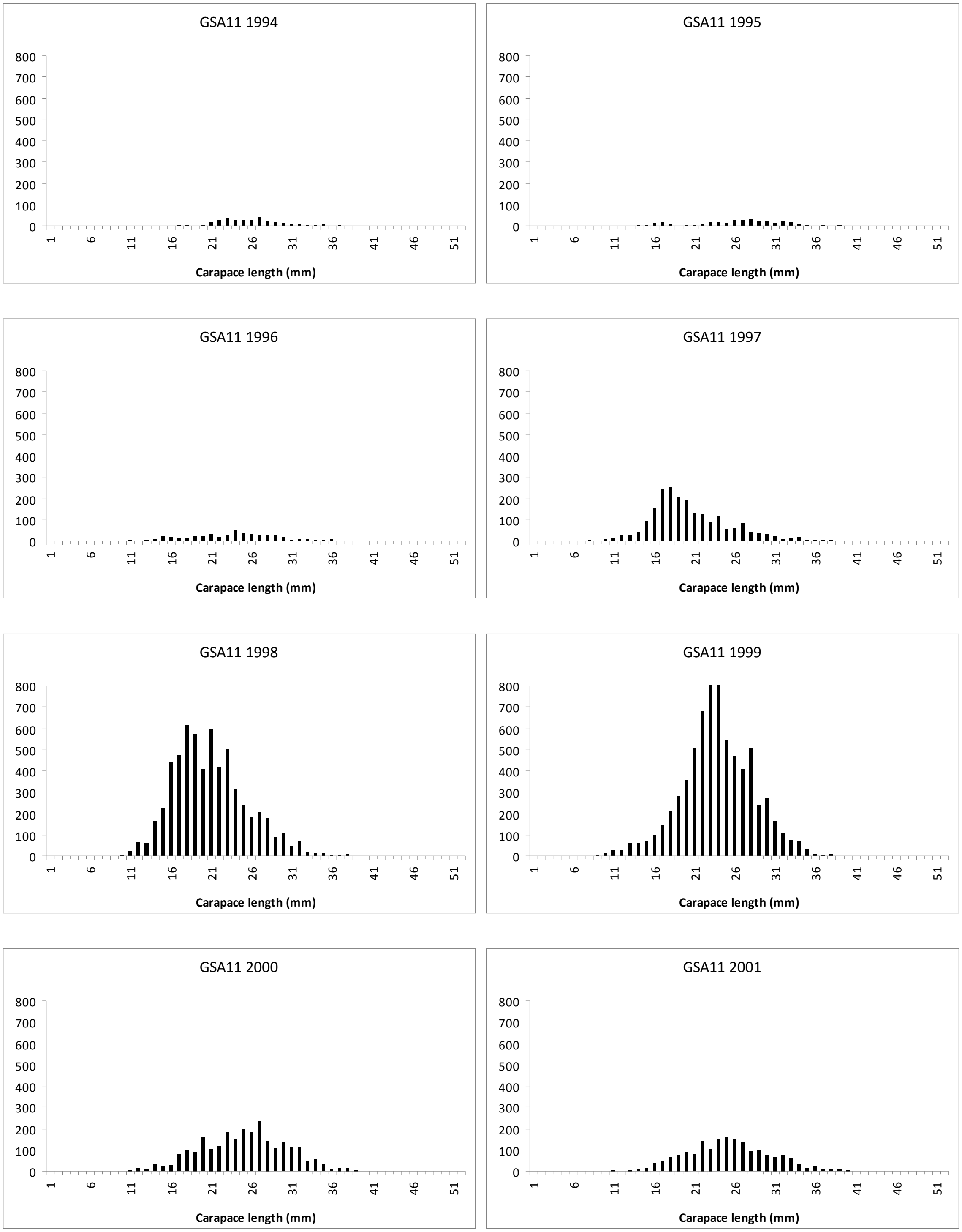


Fig. 6.9.3.1.4.1 Stratified abundance indices by size, 1994-2001.

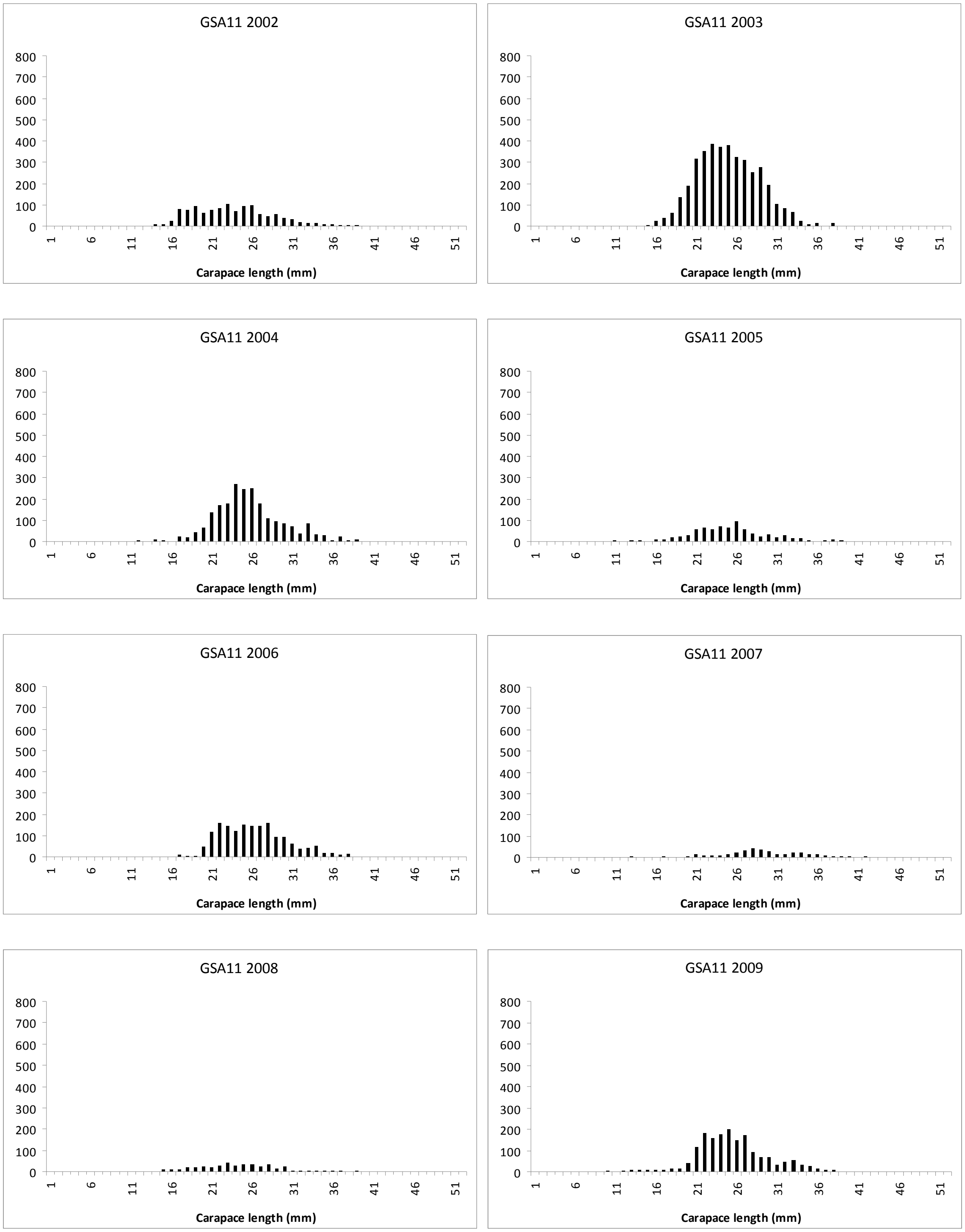


Fig. 6.9.3.1.4.2 Stratified abundance indices by size, 2002-2009.

6.9.3.1.5 Trends in growth

No information was been documented.

6.9.3.1.6 Trends in maturity

No information was been documented.

6.9.4 Assessments of historic stock parameters

6.9.4.1 Method 1: SURBA

6.9.4.1.1 Justification

The MEDITS survey provided the longer standardized time-series data on abundance and population structure of *P. longirostris* in the GSA11 which allows to utilize the SURBA software for the assessment. The SURBA assessment tool estimates the evolution of F from length frequency distribution (LFD).

6.9.4.1.2 Input parameters

The survey-based stock assessment model SURBA (Needle, 2003) was used to estimate the trend in population structure and the fishing mortality vector.

The following set of input data and parameters were used (Tab. 6.9.4.1.2.1 and 2).

Tab. 6.9.4.1.2.1 Input data used in the SURBA model.

	Survey index data (CPUE)				**Proportion mature**				**Mean weights**			
	Age				Age				Age			
Year	1	2	3	4+	1	2	3	4+	1	2	3	4+
1994	4073	735	78	11	0,8	1	1	1	16,5	18,4	24,3	29
1995	2250	1021	118	29	0,8	1	1	1	16,5	18,4	24,3	29
1996	4051	627	123	41	0,8	1	1	1	16,5	18,4	24,3	29
1997	7637	747	127	16	0,8	1	1	1	16,5	18,4	24,3	29
1998	10959	1835	179	20	0,8	1	1	1	16,5	18,4	24,3	29
1999	11928	2596	125	11	0,8	1	1	1	16,5	18,4	24,3	29
2000	8397	2899	314	52	0,8	1	1	1	16,5	18,4	24,3	29
2001	8566	2495	415	46	0,8	1	1	1	16,5	18,4	24,3	29
2002	4554	854	180	14	0,8	1	1	1	16,5	18,4	24,3	29
2003	12149	1836	160	11	0,8	1	1	1	16,5	18,4	24,3	29
2004	7714	1762	237	27	0,8	1	1	1	16,5	18,4	24,3	29
2005	4733	914	105	11	0,8	1	1	1	16,5	18,4	24,3	29
2006	9352	1495	289	41	0,8	1	1	1	16,5	18,4	24,3	29
2007	2620	1456	342	143	0,8	1	1	1	16,5	18,4	24,3	29
2008	3762	453	118	58	0,8	1	1	1	16,5	18,4	24,3	29
2009	3191	955	230	100	0,8	1	1	1	16,5	18,4	24,3	29

Tab. 6.9.4.1.2.2 Input parameters used in the SURBA model.

Growth parameters	
Linf	43,5 mm carapace length
K	0,6
t_0	0
Length-weight relationships	
a	0,00727
b	2,2101
Natural mortality	
M=0,79	
Length at maturity	
L50	24 mm carapace length
Lc100	22 mm carapace length

Standardized time series of MEDITS length-frequency-distributions were sliced into different age-groups using the same growth parameters for the whole time series.

6.9.4.1.3 Results

The fitted year effect show high fluctuations in the whole time series. Moreover a decreasing trend could be observed since 2005 (Figure 6.9.4.1.3.1). The age effect shows a flat patter with high values for stock mortality since age 3. The Fitted cohort effects are progressively decreasing from 1997.

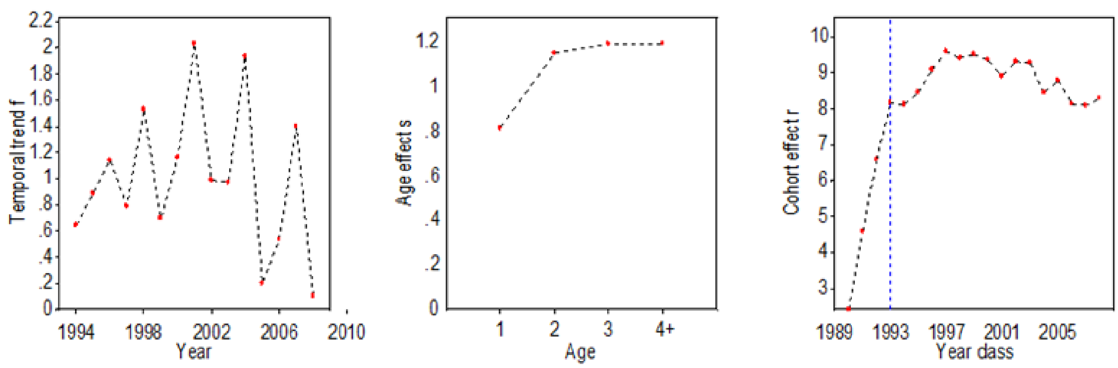


Fig. 6.9.4.1.3.1 MEDITS survey. Fitted year, age and cohort effects estimated by SURBA.

Average fishing mortality (F_{1-3}) estimated from trawl survey data (MEDITS) ranges between 0.74 and 1.55 (excluding the last year, F=0.42) with a mean value of 1.1 (Fig. 6.9.4.1.3.2). Relative indices of spawning stock biomass (SSB) showed a peak in 1999 and a successive decreasing trend that become flat to minimum values in the last years. A same pattern for the relative recruitment estimated from the MEDITS survey was observed. It is necessary to consider that, due to the season when MEDITS surveys are conducted, young of the year (0+) are poorly sampled.

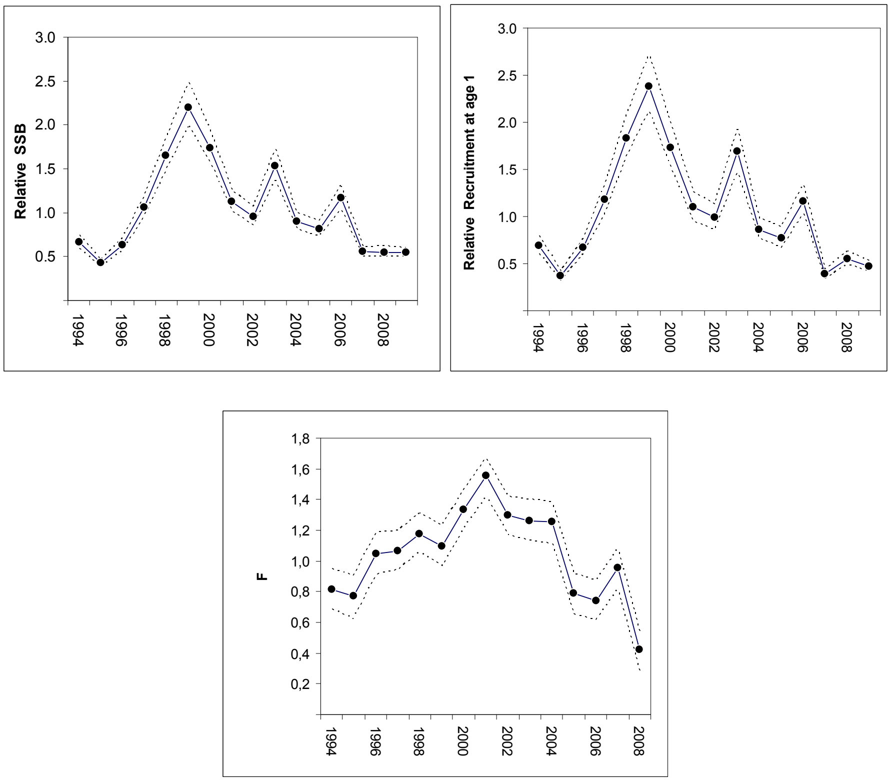
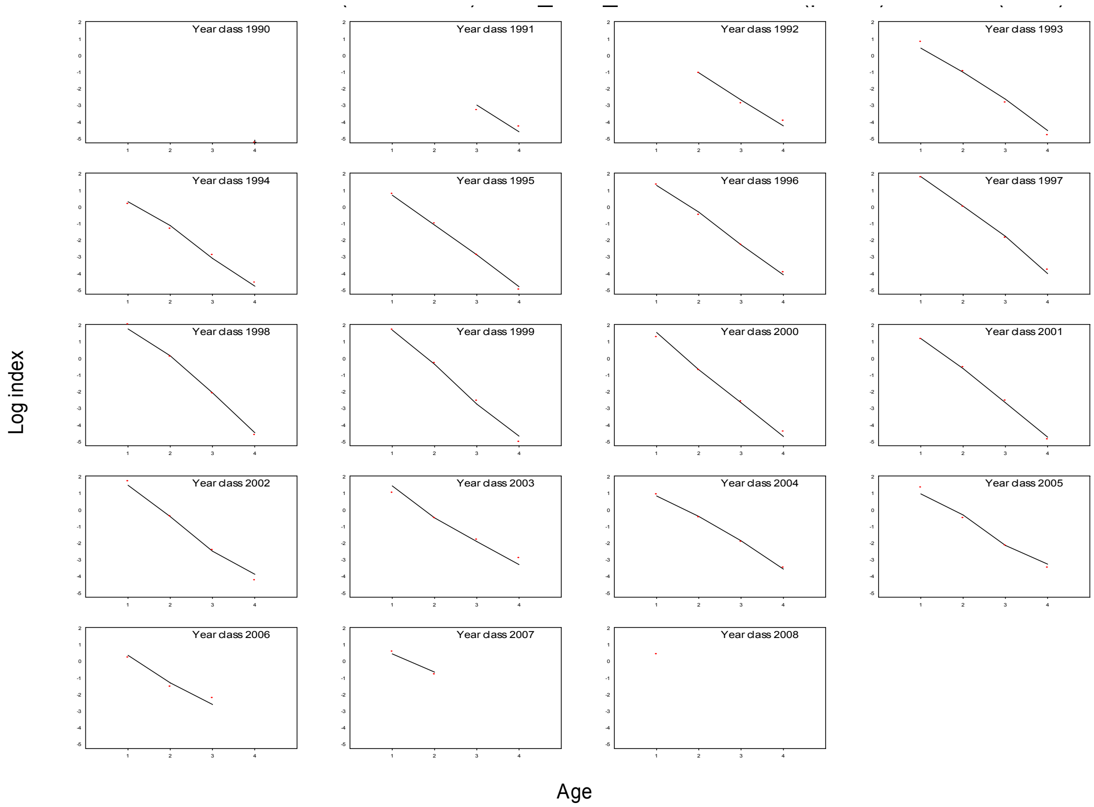


Fig. 6.9.4.1.3.2 . Estimated trend in $F_{1\text{-}3}$, relative SSB and relative recruitment index at age 1+ of *P. longirostris* in the GSA11, dotted lines are 2.5% and 97.5% confidence intervals.

The SURBA model for *P. longirostris* fits very well on survey data and do not highlight trends in the residuals as showed by the comparisons made between observed and fitted abundance indices per year, comparative scatterplot at age, catch curves and residuals of the log index abundance (Fig. 6.9.4.1.3.3).


Year class 1990
Year class 1991
Year class 1992
Year class 1993
Year class 1994
Year class 1995
Year class 1996
Year class 1997
Year class 1998
Year class 1999
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Year class 2001
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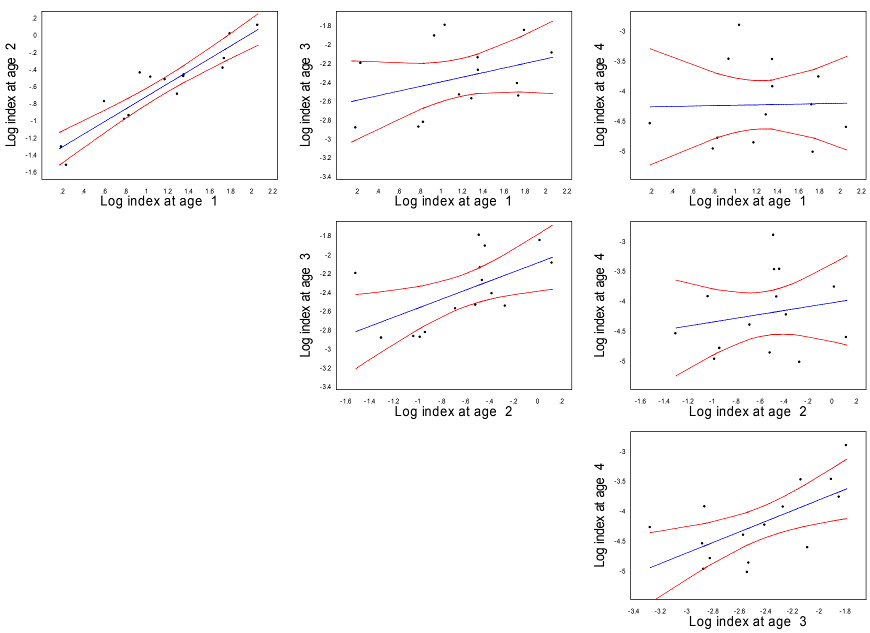
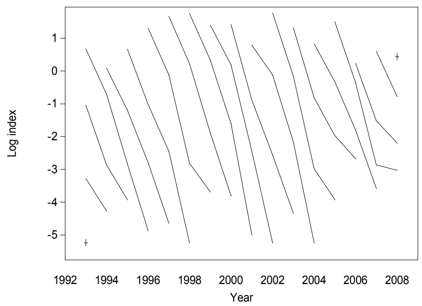
Year class 2008
Log index
Age

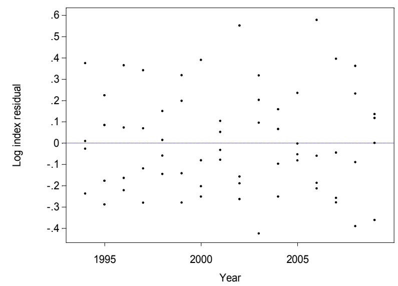
A


Log index at age 2
Log index at age 3
Log index at age 4
Log index at age 1
Log index at age 2
Log index at age 3

B



C



D

Fig. 6.9.4.1.3.3. Model diagnostic for SURBA model of in the GSA 11. A) Comparison between observed (points) and fitted (lines) MEDITS survey abundance indices, for each year; B) comparative scatterplot at age; C) Log survey abundance indices by cohort (catch curves); D) residual of the log index abundance.

6.9.4.2 Method 2: LCA

6.9.4.2.1 Justification

The pseudo-cohort analysis VIT was applied using landings data of 2009 only, because no data were submitted by the Italian authorities for previous years.

6.9.4.2.2 Input parameters

Data coming from DCR provided at EWG-11-05 contained information on deep water pink shrimp landings and the respective size structure for 2009 (Tab. 6.9.4.2.2.1). These data were used to run an LCA analysis using the VIT software. A constant M of 0.79, the same used for SURBA, was utilized.

Tab. 6.9.4.2.2.1. Input data for LCA of deep water pink shrimp in GSA11 (sex combined, 2009).

	Landings (thousand)
CL(mm)	2009
18	17
19	0
20	17
21	34
22	144
23	118
24	127
25	152
26	211
27	195
28	195
29	127
30	102
31	68
32	76
33	152
34	220
35	237
36	228
37	152
38	51
39	17
40	0

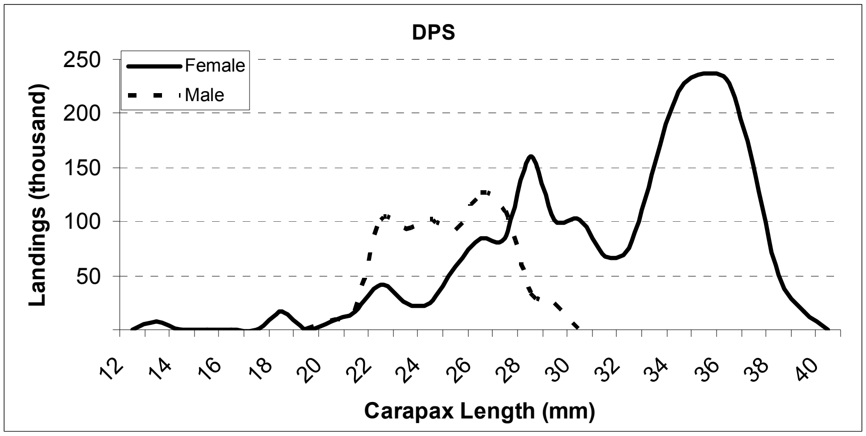
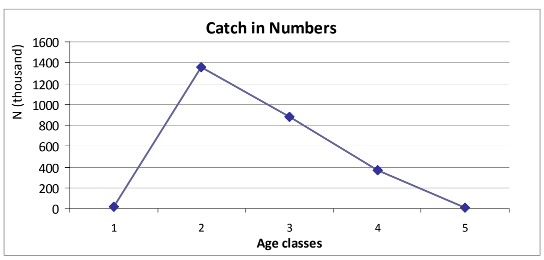


Fig. 6.9.4.2.2.1. Length frequency distributions of the landings of *P. longirostris* by sex in GSA11 (2009).

6.9.4.2.3 Results

Deep water pink shrimp landings in 2009 were concentrated on age classes 2-4 and the estimated fishing mortality rates show a peak for specimens of age class 4 (Fig. 6.9.4.2.3.1). F_{1-3} was 0.86. $F_{0.1}$ was 0.82.



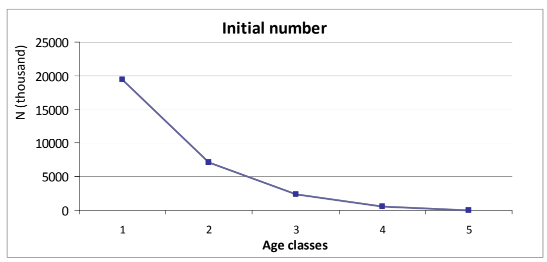


Fig. 6.9.4.2.3.1. LCA output by ages: catch numbers, initial numbers and fishing mortality of *P. longirostris* in the GSA11.

Assuming no variation in the exploitation pattern, the main results of the Y/R analysis are reported in Tab. 6.9.4.2.3.2.

Tab. 6.9.4.2.3.1 The main results of the VIT analysis.

Year	Yield (t)	Recruitment (ml)	F	Z
2009	34,7	19,4	0.86	1.65

6.9.5 Long term prediction

6.9.5.1 Method 1: Yield per recruit from VIT

6.9.5.1.1 Justification

The yield per recruit from the VIT was applied.

6.9.5.1.2 Input parameters

Input parameters were used as given in table 6.9.5.1.2.1.

Table 6.9.5.1.2.1. Input parameters to the yield per recruit analysis.

M =0.7
L_{50}=24 carapace length
L_{100}=22 carapace length VBGF: L_{inf} =43,5 carapace length; k = 0.6 t_0 = 0 Length-weight relationship: a = 0.0727; b = 2.21

6.9.5.1.3 Results

The VIT results regarding the long term prediction are presented below (Fig. 6.9.5.1.3.1).

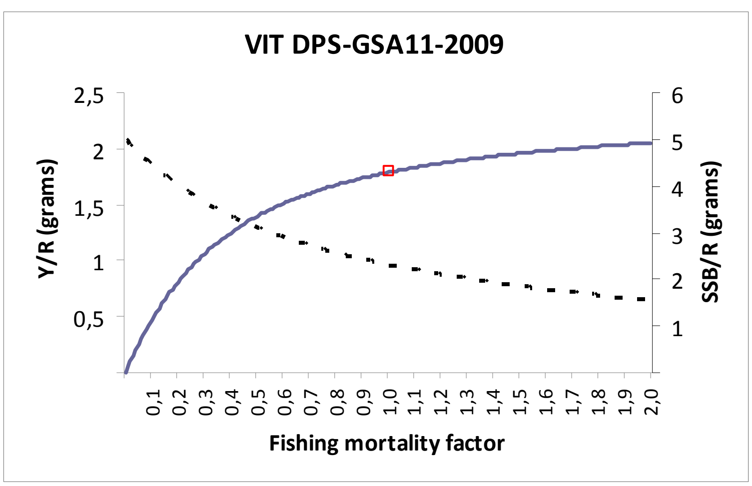


Fig. 6.9.5.1.3.1 Spawning Stock Biomass (SSB) and Yield (Y) per recruit by different level of F factor (year 2009).

It is worth to note that were only available data for one year (2009).

	F	Y/R
F0.1	0.82	1.774
Fmax	1,70	2.051

6.9.5.2 Method 1: Yield per recruit from Yield

6.9.5.2.1 Justification

The Yield software (Hoggarth *et al*., 2006), that allows for uncertainty in parameter inputs, was used to estimate $F_{0.1}$ as limit equilibrium YPR reference point for the stock assuming some uncertainty in parameters estimations.

6.9.5.2.2 Input parameters

The parameters used to estimate $F_{0.1}$ through Yield software are reported below (Tab. 6.9.5.2.2.1).

The parameters (von Bertalanffy growth parameters and length-weight relationship coefficients) were converted in TL by using the relationship reported by Crosnier et al. (1970) for combined sex (TL=2.98+4.47*CL)

Moreover a guess estimate of uncertainty in terms of coefficient of variation was added to each parameter.

Recruitment was derived from estimated of 2009 age 0 classes computation by VIT.

An estimation of F was obtained from Z – M by the Beverton and Holt Z estimator.

Tab. 6.9.5.2.2.1. Input to long term forecast.

$L\infty$ = 43.5 mm carapace length
K = 0.6
t_0 = 0
a = 0.007271
b = 2.2101
M = 0.79 CV=0.1
L_{50} = 24 mm, normally distributed CV=0.05
Lc100 = 22 mm, normally distributed CV=0.05
Spawning season: March-August
Fishing season: January-December
Stock-recruit relationship (SRR) constant recruitment 19.4 million CV=0.2; uncertainty in R0=0.1

6.9.5.2.3 Results

The probability distribution of $F_{0.1}$ (1000 simulations) was shown below (Fig. 6.9.5.2.3.1). Uncertainty in model parameters produced considerable variations in $F_{0.1}$ which ranged between 0.60 and 1.33 (mean = 0.89). comment: such level of uncertainty has been arbitrarily supplied in input by the author

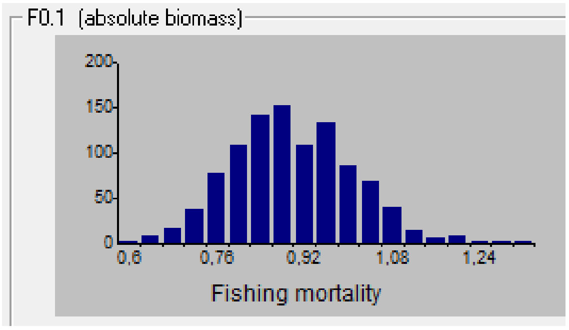


Fig. 6.9.5.2.3.1 Probability distribution of $F_{0.1}$ obtained using the Yield software.

According to these calculations, Fcurr (0,86 from VIT) was slightly below the average (0.89) and far below from the maximum (1.33) estimated $F_{0.1}$ values.

6.9.6 *Data quality*

Landings before 2009 were not submitted by the Italian authorities. SGMED was thus not able to consider more than one year for the VIT analysis.

6.9.7 *Scientific advice*

6.9.7.1 Short term considerations

6.9.7.1.1 *State of the stock size*

SSB indices from Medits survey showed a decreasing trend during the last 10 years with the highest value in 1999. Since no precautionary level for the stock of pink shrimp in GSA 11 was proposed, EWG 11-05 cannot evaluate the stock status in relation to the precautionary approach.

6.9.7.1.2 *State of recruitment*

Recruitment indices show a consistent decline since 1999 with some variation to a very low level in 2007-2009.

6.9.7.1.3 *State of exploitation*

EWG 11-05 proposes $F_{0.1} \leq 0.82$ as limit management reference point consistent with high long term yields (Fmsy proxy).

According to the F estimates obtained by applying SURBA routines to MEDITS trawl surveys indices, fishing mortality has declined since 2002.

The F estimate through LCA on the last year of landing data (2009). F1-3 = 0.86, which is positioned little below the estimated reference value of $F_{0.1}$=0.89. Given the data constraints in commercial fisheries data and the strong signals in population dynamics as indicated from the MEDITS survey, EWG 11-05 is unable to conclude on the exploitation status of the stock. Given the indicated low stock size and recruitment EWG 11-05 advises to reduce the fishing effort directed towards pink shrimp.

6.10 Stock assessment of striped red mullet in GSAs 15 and 16

6.10.1 Stock identification and biological features

6.10.1.1 Stock Identification

Whilst it is known that *Mullus surmuletus* is found in muddy and rocky habitats along the littoral zone and has pelagic eggs as well as pelagic larvae (Hureau 1986; Sabates 1990), the biological features of this species have not been studied as extensively as those of *Mullus barbatus*. The limited information that is available on striped red mullet stock identification for the Mediterranean comes from studies of this species' population genetics (Mamuris et al. 1998; Mamuris et al. 2001; Galarza et al. 2007; Galarza et al. 2009). Using microsatellite markers, Galarza et al. 2009 found that *M. surmuletus* had less genetic heterongeneity within the Mediterranean sea than *M. barbatus*, which was characterised by highly structured genetic distributions. Thus whist red mullets in the Mediterranean seem to be composed of independent, self-recruiting but interconnected subpopulations, striped red mullet populations seem to be more connected and stock stucture thus more homogeneous. These results confirm earlier work based on allozyme patterns carried out by Mamuris er al. (1998), who found significant differences in allele frequencies in *M.barbatus* samples, but none in *M. surmuletus* samples.

In the present assessment it was thus assumed that striped red mullets in GSA 15 and GSA 16 are part of a single population, and available data from the two GSAs was combined.

6.10.1.2 Growth

The Von Bertalanffy Growth Function parameters by sex available in the scientific literature are reported in Table xx, and length weight relationship parameters in Table 6.10.1.2.1. Overall, *M. surmuletus* is a fast growing species, with males growing at slightly faster rates.

Table 6.10.1.2.1 - Von Bertalanffy growth function parameters of *M. surmuletus*

			Females			Males			Combined		
Author	**Area**	**Comment**	L_{inf}	**k**	t_0	L_{inf}	**k**	t_0	**Linf**	**k**	**t0**
Pajuelo 1997	Canary Islands								35.71	0.22	
Andaloro 1982	Tyrrhenian & Ionian		30.10	0.24	-2.68	35.00	0.30	-2.39			
Renones et al. 1995	Majorca	Otoliths	31.90	0.21	-2.61	25.50	0.27	-2.45	31.28	0.21	-2.35
Andaloro & Prestipino 1985	Strait of Sicily								27.50	0.45	
Ragonese et al. 2004	Strait of Sicily	Otoliths and LFDA	29.00	0.48	-0.84	25.00	0.50	-0.20			
SGMED 01-2011	Strait of Sicily	Otoliths	32.27	0.17	-2.83	24.49	0.268	-2.45			

Table 6.10.1.2.2 - *M. surmuletus* length-weight relationship parameters

Author	Area	Females a	Females b	Males a	Males b	Combined a	Combined b
Pajuelo 1997	Canary Islands					0.007	3.183
Ragonese et al. 2004	Strait of Sicily		2.90-3.04		2.94-3.11		
MCFS 2010	Malta	0.009	3.065	0.008	3.125	0.007	3.163
SGMED 01-2011	Strait of Sicily	0.013	2.988	0.015	2.933		

6.10.1.3 Maturity

Striped red mullet reproduction in the Strait of Sicily has been reported to occur in spring / summer (Ragonese et al. 2004). The same authors report a length of 50% maturity for females of 19.5 cm, but more recent estimates from the Maltese Islands gave values of 15.9 cm for females and 14.7 cm for males. In the Balearic Islands 50% maturity in males and females is reached at 15 and 16.8 cm (Renones et al. 1995), when fish have reached one year of age. In the Canary Islands 50% maturity for both sexes combined has been estimated to be reached at 16 cm (Pajuelo et al., 1993).

Table 6.10.1.3.1 - *M. surmuletus* length at 50% maturity ($L_{50\%}$)

		Females	Males
Author	Area	$L_{50\%}$ (cm)	$L_{50\%}$ (cm)
Ragonese et al. 2004	Strait of Sicily	19.5	
Renones et al. 1995	Balearic Islands	16.8	15
Pajuelo et al. 1993	Canary Islands	16.6	
MCFS 2010	Malta	15.9	14.7

6.10.2 Fisheries

6.10.2.1 General description of fisheries

Striped red mullet (*M. surmuletus*) is an important demersal resource of the coastal areas in the Mediterranean, fished by otter trawl and trammel nets, together with other several species. Striped red Mullet is caught together with other important species such as *Mullus barbatus, Merluccius merluccius, Pagellus sp., Uranoscopus scaber, Raja sp., Trachinus sp., Octopus vulgaris, Sepia officinalis, Eledone sp.* and *Lophius sp.* In GSA 15 and 16 striped red mullet is caught almost exclusively by trawlers operating inshore on shelf fishing-grounds.

The Italian and Maltese trawlers operating in the Strait of Sicily use the same typology of trawl net called "Italian trawl net". Although some differences in material between the net used in shallow waters ("banco" net, mainly targeting shelf fish and cephalopods) and that employed in deeper ones ('fondale' net, mainly targeting deep water crustaceans) exist, the Italian trawl net is characterized by a low vertical opening (up to 1.5 m) with dimensions changing with engine power (Fiorentino *et al*., 2003a).

6.10.2.2 Management regulations applicable in 2010 and 2011

At present there are no formal management objectives for striped red mullet fisheries in the Strait of Sicily. As in other areas of the Mediterranean, the stock management is based on control of fishing capacity (licenses), fishing effort (fishing activity), technical measures (mesh size and area/season closures). A compulsive fishing ban for 30 days was adopted by Sicilian Government (August –September).

In order to limit the over-capacity of fishing fleet, no new fishing licenses have been assigned in Italy since 1989, and a progressive reduction of the trawl fleet capacity is occurring. Maltese fishing licenses have been fixed at a total of 16 trawlers since 2000. Eight new licences were however issued in 2008, a move made possible under EU law by the reduction of the capacities of other Maltese fishing fleets.

In terms of technical measures, the new regulation EC 1967 of 21 December 2006 fixed a minimum mesh size of 40 mm for bottom trawling of EU fishing vessels (Italian and Maltese trawlers). Mesh size had to be modified to square 40 mm or diamond 50 mm in July 2008, and derogations were only possible up to 2010.

The regulation EC/1626/1994 fixed the minimum marketable size of *Mullus* spp. at 11 cm total length. This minimum length, was confirmed in the Mediterranean Regulation 1967/2006, and is valid for both Italian and Maltese fishing boats operating in the area.

The Maltese Islands are surrounded by a 25 nautical miles (nm) fisheries management zone, where fishing effort and capacity are being managed by limiting vessel sizes, as well as total vessel engine powers (EC 813/04; EC 1967/06). Trawling is allowed within this designated conservation area, however only by vessels not exceeding an overall length of 24m and only within designated areas. Such vessels fishing in the management zone hold a special fishing permit in accordance with Article 7 of Regulation (EC) No 1627/94, and are included in a list containing their external marking and vessel's Community fleet register number (CFR) to be provided to the Commission annually by the Member States concerned. Moreover, the overall capacity of the trawlers allowed to fish in the 25nm zone can not exceed 4 800 kW. The total fishing effort of all vessels is not allowed to exceed an overall engine power and tonnage of 83 000 kW and 4 035 GT respectively. The fishing capacity of any single vessel with a license to operate at less than 200m depth can not exceed 185 kW. In addition, the use of all trawl nets within 1.5nm of the coast is prohibited according to EC regulation 1967 / 2006, although again a transitional derogation is at present in place until 2010.

6.10.2.3 Catches

6.10.2.3.1 Landings

Demersal otter trawlers were responsible for the great majority of striped red mullet landings in 2005-2010, with an average of 93.6% of *M. surmuletus* landings recorded through the DCF in GSAs 15 and 16 recoded for this metier.

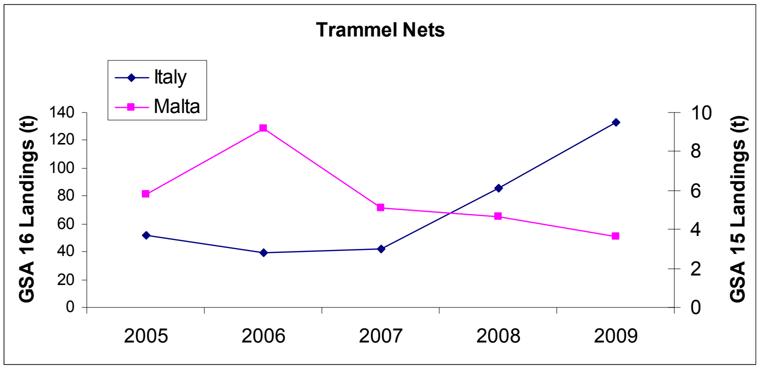


Figure 6.10.2.3.1.1. *M. surmuletus* trammel net landings recorded in 2005-2009 in GSAs 15 and 16.

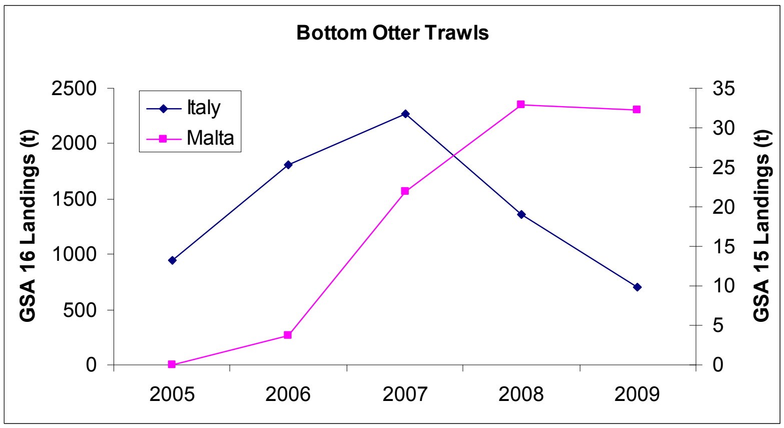


Figure 6.10.2.3.1.2. *M. surmuletus* bottom otter trawl landings recorded in 2005-2009 in GSAs 15 and 16.

The contribution of striped red mullet landings to total bottom otter trawl landings varied from 4.2% in 2007 to 1.5% in 2005 and 2010. Overall landings of striped red mullet peaked at 2341 tonnes in 2007, and the lowest value was recorded in 2009 with 869 tonnes.

Table 6.10.2.3.1.1 Annual landings (t) by fishing technique as reported to SGMED-10-03 through the DCF data call.

Species	Area	Country	FT_LVL4	2005	2006	2007	2008	2009
MUR	16	ITA	OTB	949.9	1803.5	2271.7	1354.8	700.1
MUR	16	ITA	GTR	51.5	39.3	42.1	85.8	133.2
MUR	15	MT	OTB	0.0	3.7	22.0	33.0	32.2
MUR	15	MT	GTR	5.8	9.2	5.1	4.7	3.6
MUR	**15 & 16**	**ITA & MT**	**TOTAL**	**1007.2**	**1855.7**	**2340.9**	**1478.3**	**869.2**

6.10.2.3.2 Discards

No information on striped red mullet discards data from GSAs 15 / 16 was available to EWG 11-05.

6.10.2.3.3 Fishing effort

Specific effort data for *M. surmuletus* are not available. Table 6.10.2.3.3.1 lists the effort by fishing technique deployed in GSAs 15 and 16 as reported to SGMED-01-2011 through the DCF data call. The contribution made by the Maltese fleet to the fishing effort exerted in the Strait of Sicily on average in 2004-2009 is 0.29% for trammel nets and 1.1% for bottom otter trawlers. For trammel nets the relative contribution has decreased from 0.55% in 2005 to 0.07% in 2009, whilst for trawlers it increased from 0.34% in 2005 to 1.9% in 2009 (Figure 6.10.2.3.3.1).

Tab. 6.10.2.3.3.1 Effort (GT * days at sea) trends by fishing technique in GSAs 15 and 16, 2004-2009.

	Italy		Malta		Total	
Year	**GTR**	**OTB**	**GTR**	**OTB**	**GTR**	**OTB**
2005	211199	7395504	1173	24878	212372	7420382
2006	175905	7323181	477	34527	176382	7357708
2007	219049	7299984	1023	69269	220072	7369253
2008	163047	5642204	570	109332	163617	5751536
2009	194486	6002819	146	113442	194632	6116261

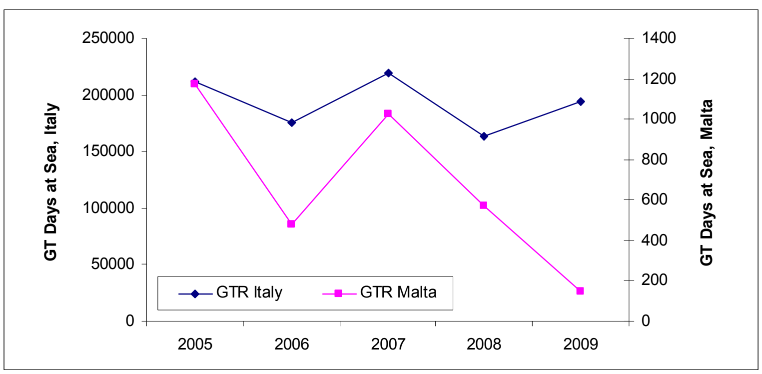


Figure 6.10.2.3.3.1. Trammel net fishing effort recorded in 2005-2009 in GSAs 15 and 16.

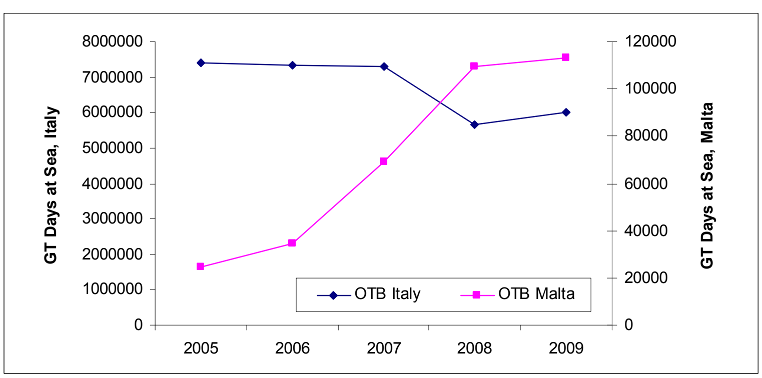


Figure 6.10.2.3.3.2. Bottom otter trawl fishing effort recorded in 2005-2009 in GSAs 15 and 16.

6.10.3 Scientific surveys

6.10.3.1 MEDITS

6.10.3.1.1 Methods

Based on the DCF data call, abundance and biomass indices were recalculated.

In order to collect fisheries independent data, which is a requirement of the EU DCF (Council Regulation 199/2008, Commission Regulation 665/2008, Commission Decision EC 949/2008 and Commission Decision 93/2010), the MEDITS international trawl survey is carried out in GSAs 15 and 16 on an annual basis. The following number of hauls was reported per depth stratum in 1994-2009 (GSA 16) and 2002-2009 (GSA 15):

Tab. 6.10.3.1.1.1. Number of hauls per year and depth stratum in GSA 16, 1994-2009.

Depth (m)	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
10-50	4	4	4	4	4	4	4	4
50-100	8	8	8	8	8	8	7	8
100-200	4	4	4	4	5	5	6	5
200-500	10	11	11	12	11	11	11	11
500-800	10	14	14	13	14	14	14	14
Depth (m)	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
10-50	7	7	7	10	10	11	11	11
50-100	11	12	12	20	22	23	23	23
100-200	10	8	9	18	19	21	21	21
200-500	19	18	19	28	31	27	27	27
500-800	19	20	19	32	33	38	38	38

Tab. 6.10.3.1.1.2. Number of hauls per year and depth stratum in GSA 15, 2002-2009.

Depth (m)	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
10-50	1	1	2	1	1	0	0	0
50-100	5	5	4	5	5	12	6	6
100-200	13	13	13	13	13	12	13	14
200-500	10	10	10	9	10	4	9	10
500-800	16	16	15	17	16	17	17	15

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). A limited number of obvious data errors were corrected and catches by haul were standardized to 60 minutes haul duration. Only hauls noted as valid were used, including stations with no catches of hake, red mullet or pink shrimp (i.e. zero catches were included).

The abundance and biomass indices were subsequently calculated by stratified means (Cochran, 1953; Saville, 1977). This implies weighing average values of the individual standardized catches as well as the variation of each stratum by the respective stratum area:

$Yst = \Sigma (Yi*Ai) / A$ $\quad\quad$ $V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:

A = total survey area
Ai = area of the i-th stratum
si = standard deviation of the i-th stratum
ni = number of valid hauls of the i-th stratum

n = number of hauls in the GSA
Yi = mean of the i-th stratum
Yst = stratified mean abundance
V(Yst) = variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t (student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions about the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien *et al.* 2004).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

6.10.3.1.2 Geographical distribution patterns

The striped red mullet *Mullus surmuletus* occurs throughout the Mediterranean, the Black Sea and in the Eastern Atlantic from the North Sea to the northern part of West Africa (Bauchot 1987).

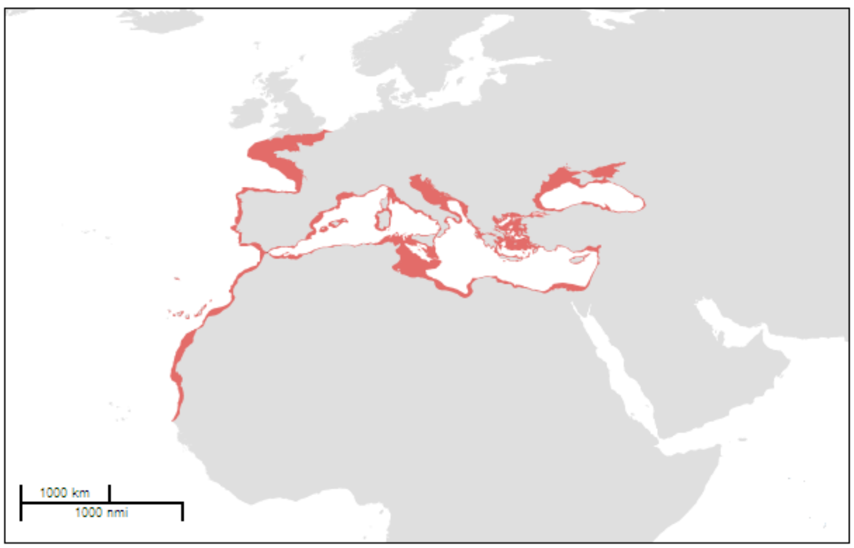


Figure 6.10.3.1.2.1. Geographical distribution of striped red mullet, *Mullus surmuletus*.
Source: http://www.fao.org/fishery/species/3207/en

6.10.3.1.3 Trends in abundance and biomass

Biomass indices were derived from scientific surveys in spring-summer (MEDITS) and autumn (GRUND; GSA 16 only). The average MEDITS SBI in 2007-2010 was 13.66 kg/km^2, compared to 6.41 kg/km^2 in 2003-2006. Although this indicates a relative recovery of SB, average BI over the earliest years of the time series (1994-2002) was 13.72, indicating that overall SB levels have remained constant without consistent trend. Trends in density indices reflected these patterns.

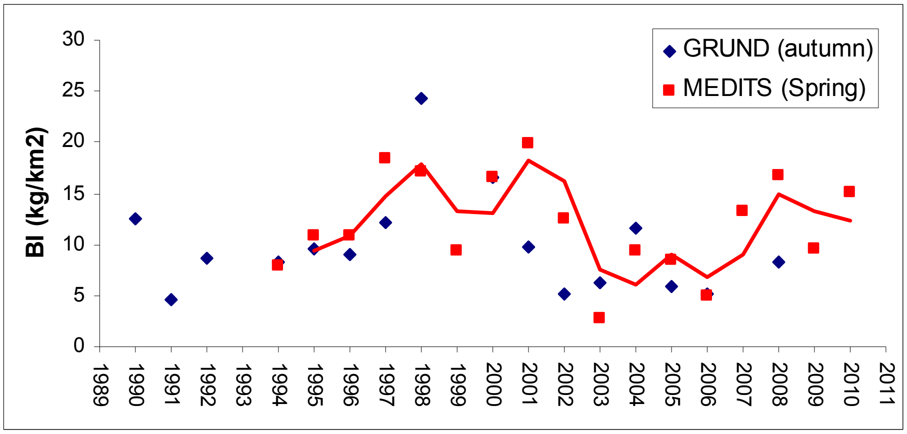


Fig. 6.10.3.1.3.1 Biomass indices derived from scientific surveys in spring-summer (MEDITS) and autumn (GRUND).

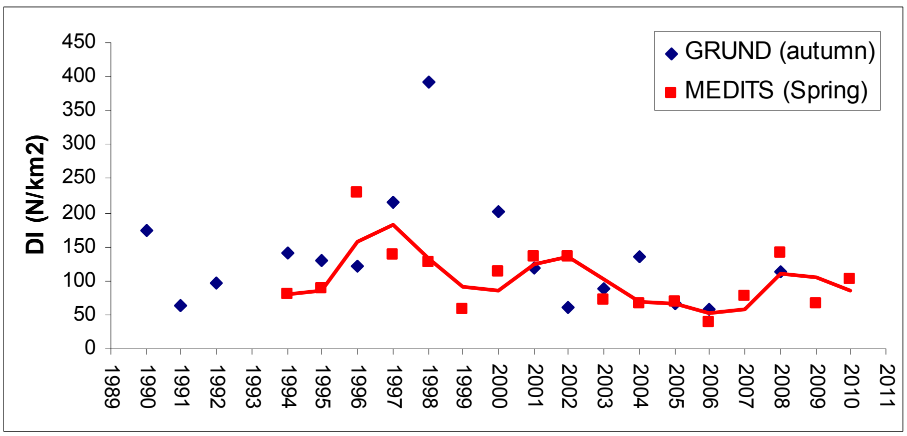


Fig. 6.10.3.1.3.2 Density indices (n) derived from scientific surveys in spring-summer (MEDITS) and autumn (GRUND).

6.10.3.1.4 Trends in abundance by length or age

The following Fig. 6.10.3.1.4.1-3 display the MEDITS abundance indices by size in 1994-2001 and 2002-2007, and 2008-2010, respectively.

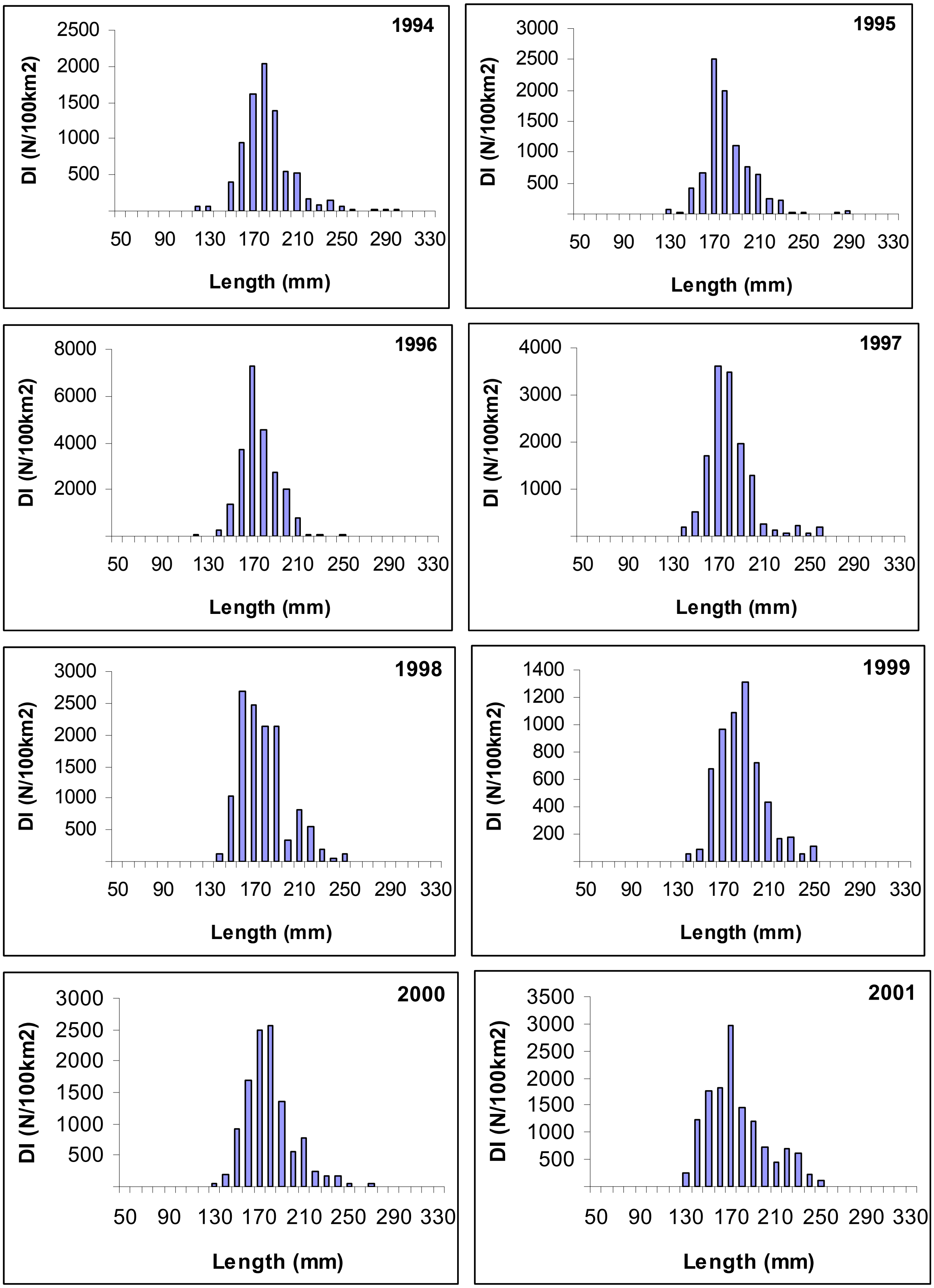


Fig. 6.10.3.1.4.1 Length frequencies of striped red mullet, 1994-2001.

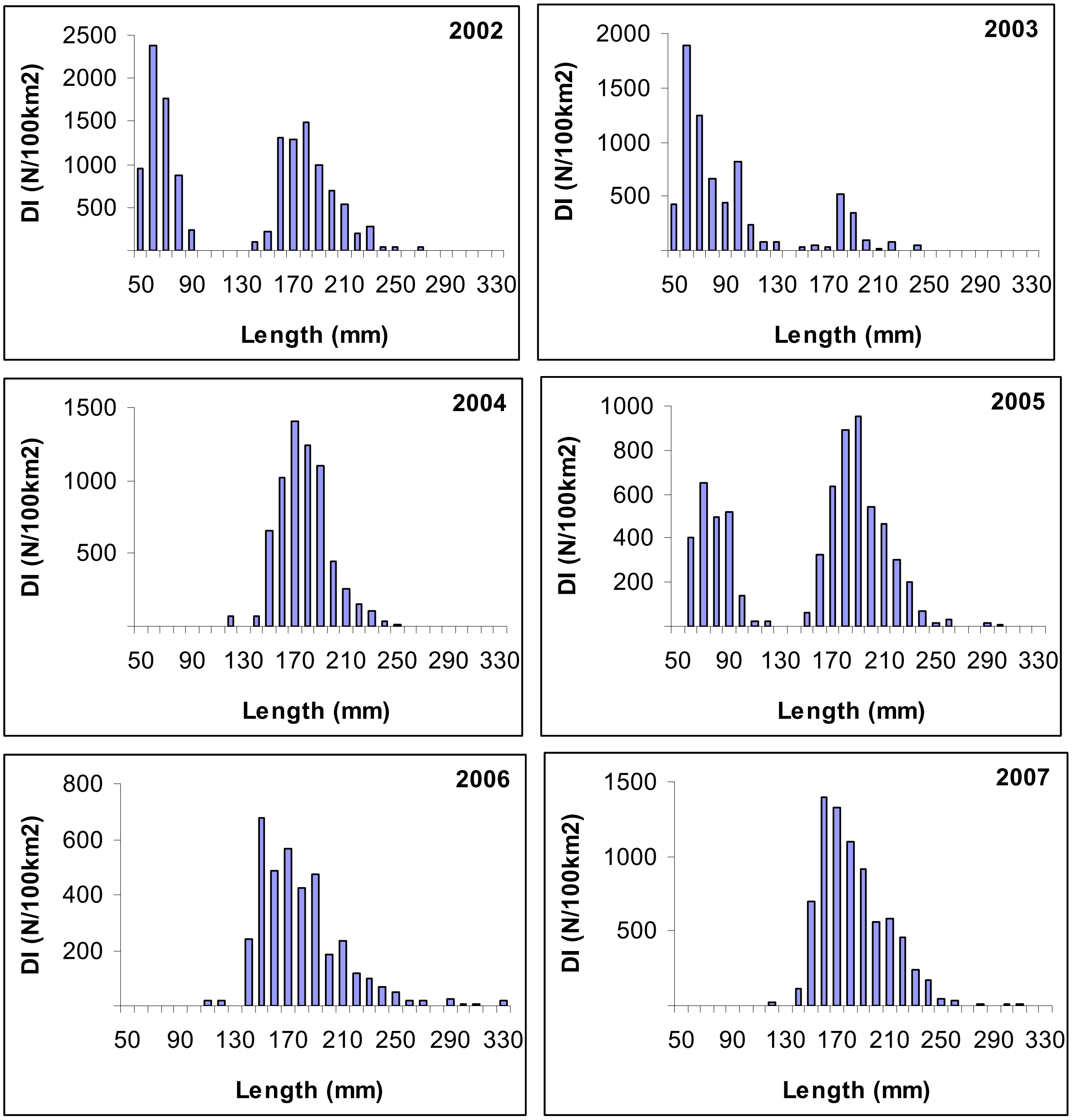


Fig. 6.10.3.1.4.2 Length frequencies of striped red mullet, 2002-2007.

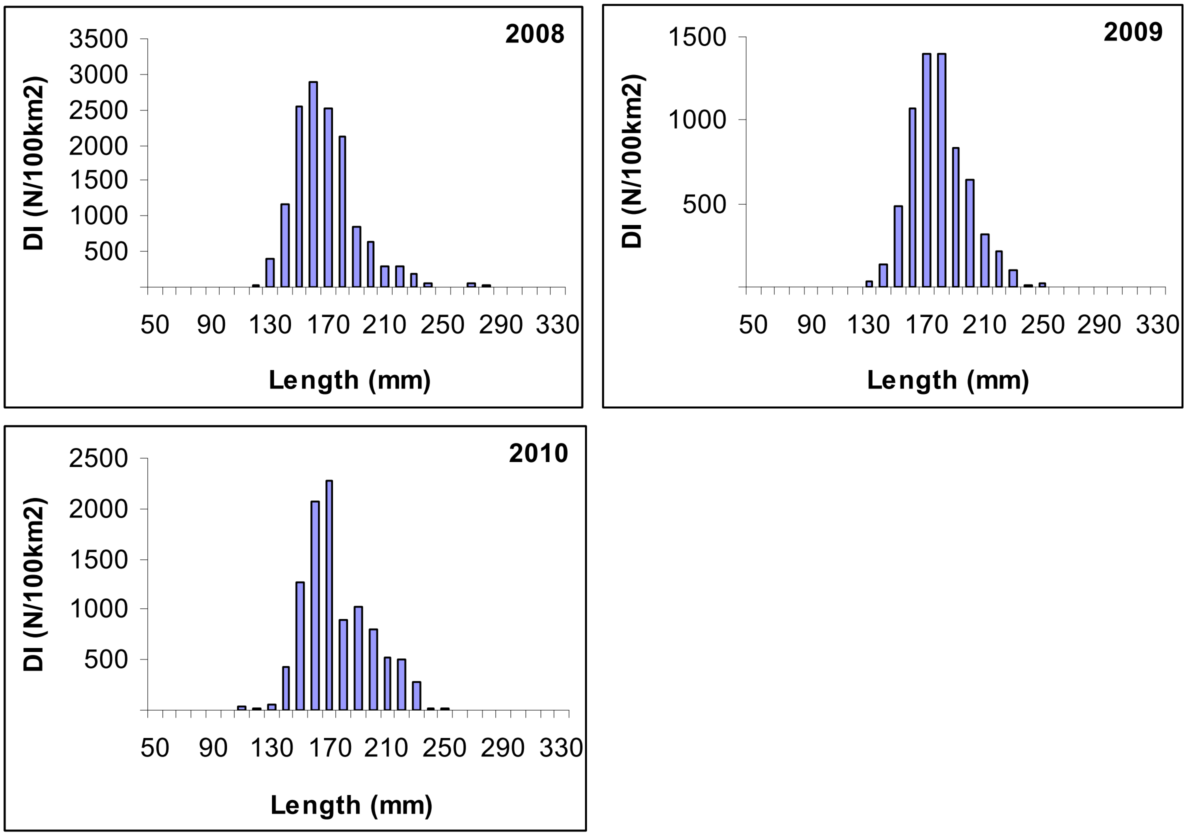


Fig. 6.10.3.1.4.3 Length frequencies of striped red mullet, 2008-2010.

6.10.3.1.5 Trends in growth

No information was been documented.

6.10.3.1.6 Trends in maturity

No information was been documented.

6.10.4 Assessments of historic stock parameters

6.10.4.1 Method 1: Catch curve analyses

6.10.4.1.1 Justification

A catch curve analysis was performed in order to evaluate potential trends in total mortality.

A long time series of survey data was available to SGMED 01-2011, so an estimation of fishing mortality based on a catch curve analysis of this data was carried out. Both annual trends and trends based on 4 year averages were analysed.

6.10.4.1.2 Input parameters

Standardised MEDITS LFDs by sex were 'age sliced' using the software package LFDA 5 (Kirkwood *et al*., 2001). Taking into account the differences in male and female growth parameters, age slicing was done keeping sexes separated. Results were subsequently combined to obtain age frequency distributions for the entire population.

Table XX. Results of age spicing carried out based on length frequency distributions of MEDITS survey data (1994-2010) used as input data for the catch curve analysis. Only final results for males and females combined are shown.

		1994	1995	1996	1997	1998
Age Class	0	7.84	0.00	83.71	0.00	0.00
	1	1184.54	1020.19	4728.85	2102.81	3079.29
	2	4887.26	5417.72	14401.78	8722.53	6990.39
	3	1454.44	1623.24	3487.78	2247.31	1637.48
	4	367.25	527.76	119.92	261.93	732.61
	5	114.47	39.67	58.77	214.76	173.51
	6+	123.36	85.56	43.52	139.62	0.00
		1999	**2000**	**2001**	**2002**	**2003**
Age Class	0	0.00	12.72	27.28	0.00	256.70
	1	724.95	2445.29	4508.92	1307.57	208.45
	2	2908.16	6411.27	5494.69	3829.53	760.07
	3	1748.76	1634.83	2064.43	1491.62	308.41
	4	340.91	691.70	1012.28	492.19	70.90
	5	132.80	112.17	324.15	45.33	16.30
	6+	0.00	60.28	30.96	36.60	0.00
		2004	**2005**	**2006**	**2007**	**2008**
Age Class	0	72.96	45.42	42.04	19.00	100.54
	1	1500.73	297.07	1283.66	1901.67	6130.32
	2	3647.66	2195.69	1398.37	3326.87	6099.24
	3	1078.27	1384.18	611.10	1405.70	1257.33
	4	230.75	512.36	254.75	701.80	376.74
	5	50.27	58.80	62.45	195.50	58.75
	6+	0.00	31.23	25.92	93.55	97.48
		2009	**2010**			
Age Class	0	0.00	69.76			
	1	1498.60	3207.42			
	2	3604.18	4487.45			
	3	1281.63	1641.00			
	4	228.93	647.96			
	5	33.38	145.41			
	6+	4.53	20.61			

6.10.4.1.3 Results

Total mortality (Z) estimations ranged from 0.92 (1992) to 1.99 (1996). In 2008-2009 Z ranged from 1.12 to 1.58, and the overall average Z was 1.3. The results of the catch curve analysis combining years gave similar results, with Z estimations ranging from 1.1 (1998-2001) to 1.50 (1994-1997), and an overall average Z of 1.3.

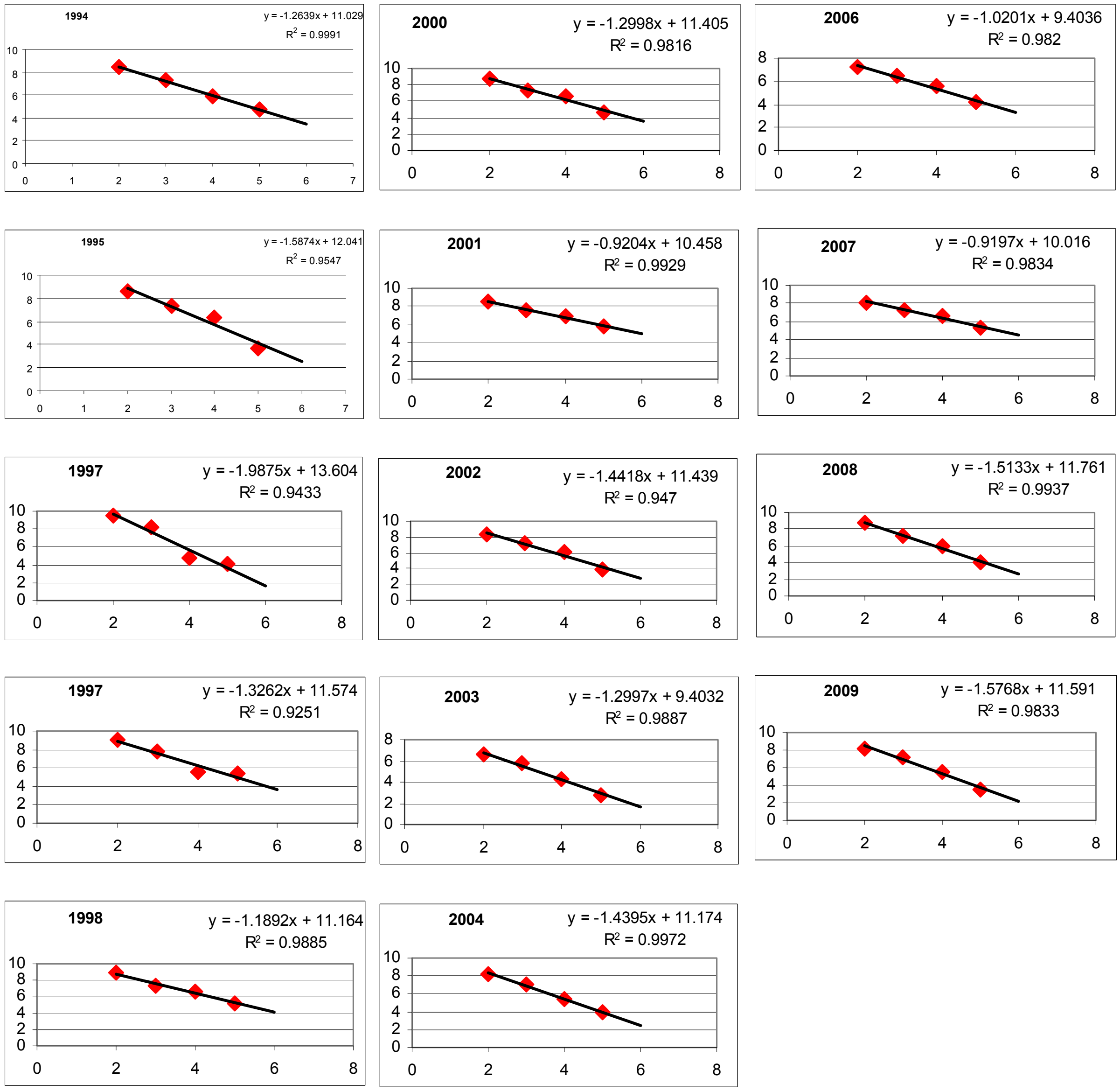


Figure 6.10.4.1.3.1. Z estimation from catch curve analysis based on MEDITS survey data (1994-2009); x axis refers to age, y axis refers to natural log of MEDITS DI by age; analysis was carried out for ages 2-5.

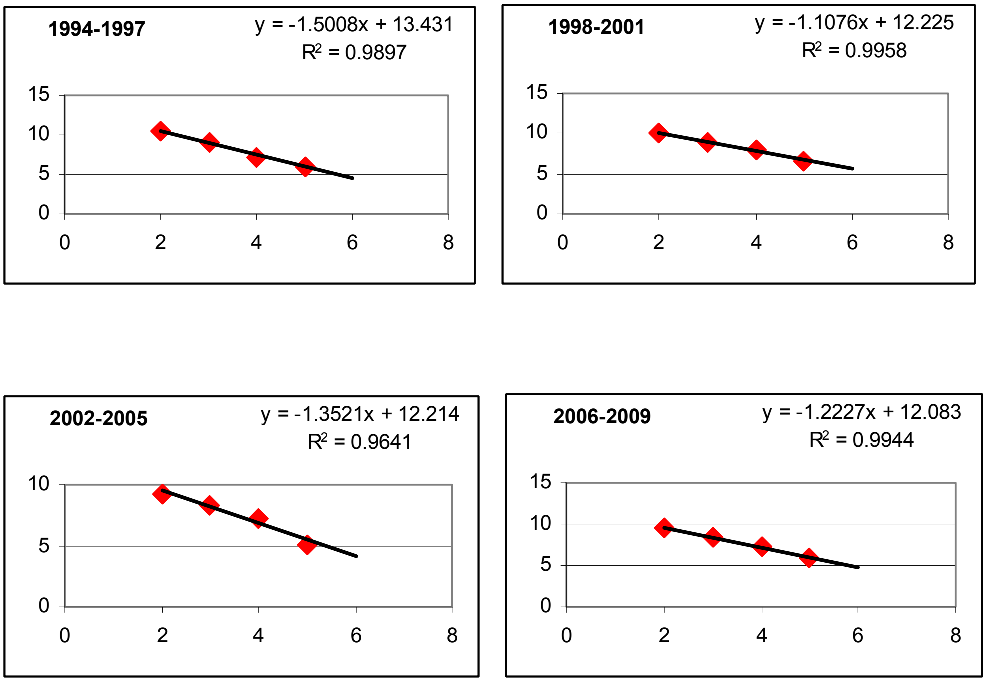


Figure 6.10.4.1.3.2. Z estimation from catch curve analysis based on MEDITS survey data 1994-1997, 1998-2001, 2002-2005 and 2006-2009 combined; x axis refers to age, y axis refers to natural log of MEDITS DI by age; analysis was carried out for ages 2-5.

Table 6.10.4.1.3.1. Results of Z estimations based on the *M. surmuletus* catch curve analyses.

Year	Z	Average Z
1994	1.26	1.50
1995	1.59	
1996	1.99	
1997	1.33	
1998	1.19	1.11
1999	1.08	
2000	1.3	
2001	0.92	
2002	1.44	1.35
2003	1.3	
2004	1.43	
2005	1.19	
2006	1.02	1.22
2007	0.92	
2008	1.51	
2009	1.58	

6.10.5 Long term prediction

6.10.5.1 Justification

No analyses performed by EWG 11-05.

6.10.5.2 Input parameters

Not data available.

6.10.5.3 Results

No results obtained.

6.10.6 Data quality

The major shortfall is the lack of relevant size/age compositions from fisheries landings and discards.

6.10.7 Scientific advice

6.10.7.1 Short term considerations

6.10.7.1.1 State of the stock size

Biomass indices derived from scientific surveys in spring-summer (MEDITS), which are representative of SSB, do not indicate a significant trend in stock size during 1994-2010. In the absence of proposed precautionary reference points and absolute stock size estimations EWG 11-05 is unable to fully evaluate the state of the stock size.

6.10.7.1.2 State of recruitment

The time series of recruitment indices from trawl surveys in autumn (GRUND surveys) carried out in GSA 16 (individuals smaller than 15 cm TL) showed a peak in 1997 and in 1998. Since 2001, recruitment is indicated to be relatively low.

6.10.7.1.3 State of exploitation

EWG 11-05 is unable to advise on specific management reference points consistent with high long term yields.

In the absence of proposed management reference points and given the data availability and analysis undertaken, EWG 11-05 is unable to conclude on the exploitation status of the stock and provide consistent advice.

6.11 Stock assessment of thornback skate in GSAs 15 and 16

6.11.1 Stock identification and biological features

6.11.1.1 Stock Identification

Thornback ray (*Raja clavata* L., 1758) is present in the eastern Atlantic and all around the Mediterranean and Black Seas. It is a benthic species that lives over a wide depth range from shallow coastal waters down to 700m depth and inhabits different kinds of grounds, but mainly sandy-muddy bottoms. In the Mediterranean, the species is found in the range 100–200m, whereas in the Adriatic Sea this range is reduced to 100–130m (Serena and Abella, 1999). The mean individual weight tends to increase with depth, probably due to a different distribution of individuals, depending on size, and/or to a real decrease in mean individual size due to intense fishing pressure. Spatial distribution of *Raja clavata* suggests movement of adults during the year.

The analysis of the distribution over a wider area of the Strait of Sicily does not show a segregation of sub-units in the northern sector of the Straits of Sicily (GSA 15 and 16) (Garofalo *et al.*, 2003). Therefore in the present assessment it was thus assumed that Thornback ray in GSA 15 and GSA 16 are part of a single population, and available data from the two GSAs was combined.

6.11.1.2 Growth

The Von Bertalanffy Growth Function parameters by sex available in the scientific literature are reported in Table 6.11.1.2.1, and length weight relationship parameters in Table 6.11.1.2.2.

Table 6.11.1.2.1 - Von Bertalanffy growth function parameters of *R. clavata*

			Females			Males		
Author	**Area**	**Comment**	L_{inf}	**k**	t_0	L_{inf}	**k**	t_0
Cannizzaro et al., 1995	Strait of Sicily	Vertebrae readings	126.5	0.098	-0.51	116.7	0.106	-0.41

Table 6.11.1.2.2 – *R. clavata* length-weight relationship parameters

		Females		Males		Combined	
Author	**Area**	**a**	**b**	**a**	**b**	**a**	**b**
	Malta						
SGMED 01-2011	Strait of Sicily	0.00146	3.364	0.00136	3.359		

6.11.1.3 Maturity

According to Ragonese et al. (2004) the sex ratio (F/(F+M)) is far from unity, being in favour of males (from 0.39 to 0.49).

Serena and Abella (1999) report that reproduction generally occurs during the whole year, with a peak in autumn or winter. However, in the Straits of Sicily, the maximum percentage of mature individuals is observed in autumn and the minimum, in winter (Cannizzaro *et al.*, 1995). In the Mediterranean, sexual maturity is reached at an individual length of 75cm in males and nearly 85cm in females (Serena, 2005). In the Straits of Sicily, a length at first maturity between 57cm and 59cm for males and between 77cm and 79 cm for females was observed; and the age at first maturity was estimated at about 6 years for males and 9 years for females (Cannizzaro et al., 1995).

The species produce benthic eggs in robust cases in which the juveniles develop without any larval phase (Serena, 2005). Fecundity is quite moderate and directly proportional to size: one female produces from 70 to 170 eggs each year (Holden, 1975). According to Serena (2005), in *R. clavata* the development of the embryo lasts about five months, with the young hatching at an individual total length of 100–110mm.

6.11.2 Fisheries

6.11.2.1 General description of fisheries

The importance of thornback ray (*R. clavata*) to fisheries varies between regions, but amongst rays it is the most economically valuable species. Indeed, although rays and skates are commonly landed and reported as one generic category, consisting of a number of species ('*Raja* spp.'), research has shown that *R. clavata* is the most commonly landed species of ray. *R. clavata* is frequently caught as by catch by otter trawls and bottom longlines.

6.11.2.2 Management regulations applicable in 2010 and 2011

At present there are no formal management objectives for thornback ray in the Strait of Sicily fisheries. As in other areas of the Mediterranean, the stock management is based on control of fishing capacity (licenses), fishing effort (fishing activity), technical measures (mesh size and area/season closures). A compulsive fishing ban for 30 days was adopted by Sicilian Government (August –September).

In order to limit the over-capacity of fishing fleet, no new fishing licenses have been assigned in Italy since 1989, and a progressive reduction of the trawl fleet capacity is occurring. Maltese fishing licenses have been fixed at a total of 16 trawlers since 2000. Eight new licences were however issued in 2008, a move made possible under EU law by the reduction of the capacities of other Maltese fishing fleets.

In terms of technical measures, the new regulation EC 1967 of 21 December 2006 fixed a minimum mesh size of 40 mm for bottom trawling of EU fishing vessels (Italian and Maltese trawlers). Mesh size had to be modified to square 40 mm or diamond 50 mm in July 2008, and derogations were only possible up to 2010.

No minimum marketable size of *Raja* spp. was fixed by the EC and national regulations.

The Maltese Islands are surrounded by a 25 nautical miles (nm) fisheries management zone, where fishing effort and capacity are being managed by limiting vessel sizes, as well as total vessel engine powers (EC 813/04; EC 1967/06). Trawling is allowed within this designated conservation area, however only by vessels not exceeding an overall length of 24m and only within designated areas. Such vessels fishing in the management zone hold a special fishing permit in accordance with Article 7 of Regulation (EC) No 1627/94, and are included in a list containing their external marking and vessel's Community fleet register number (CFR) to be provided to the Commission annually by the Member States concerned. Moreover, the overall capacity of the trawlers allowed to fish in the 25nm zone can not exceed 4 800 kW, and the total fishing effort of all vessels is not allowed to exceed an overall engine power and tonnage of 83 000 kW and 4 035 GT respectively. The fishing capacity of any single vessel with a license to operate at less than 200m depth can not exceed 185 kW. In addition, the use of all trawl nets within 1.5nm of the coast is prohibited according to EC regulation 1967 / 2006, although again a transitional derogation is at present in place until 2010.

6.11.2.3 Catches

6.11.2.3.1 Landings

No landings data was available to EWG 11-05 since *R. clavata* was not amongst the species for which member states were requested or invited to submit data under the DCF data call. However detailed landing and discard data is being collected for this species under the DCF since *R. clavata* is a 'group 1' species (see EC 949/2008 for definition).

6.11.2.3.2 Discards

No official information on thornback skate discards data from GSAs 15 / 16 was available to EWG 11-05. On the basis of available information on the length composition of landings in GSA 16 specimens smaller than 40 cm TL were discarded.

6.11.2.3.3 Fishing effort

Specific effort data for *R. clavata* are not available. Table 6.11.2.3.3.1 lists the effort by fishing technique deployed in GSAs 15 and 16 as reported to EWG 11-05 through the DCF data call. The contribution made by the Maltese fleet to the fishing effort exerted in the Strait of Sicily on average in 2004-2009 is 28% for longliners and 1.1% for bottom otter trawlers. For bottom longlines the relative Maltese contribution decreased from 33% in 2008 to 22% in 2009, whilst for trawlers it increased from 0.34% in 2005 to 1.9% in 2009 (Figure 6.11.2.3.3.1).

Tab. 6.11.2.3.3.1 Effort (GT * days at sea) trends by fishing technique in GSAs 15 and 16, 2004-2009.

	Italy		Malta		Total	
Year	**LLS**	**OTB**	**LLS**	**OTB**	**LLS**	**OTB**
2004	20985	7203800			271219	7203800
2005	40175	7395504	16866	24878	57041	7420382
2006	41715	7323181	18866	34527	60581	7357708
2007	49125	7299984	18072	69269	67197	7369253
2008	33627	5642204	16220	109332	49847	5751536
2009	48627	6002819	13377	113442	62004	6116261

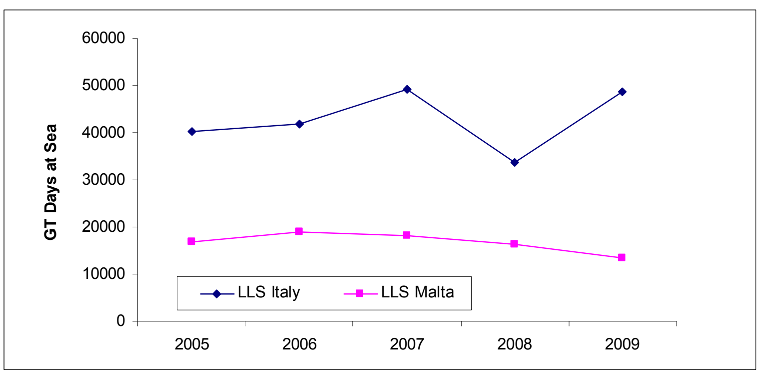


Figure 6.11.2.3.3.1. Bottom longline fishing effort recorded in 2005-2009 in GSAs 15 and 16.

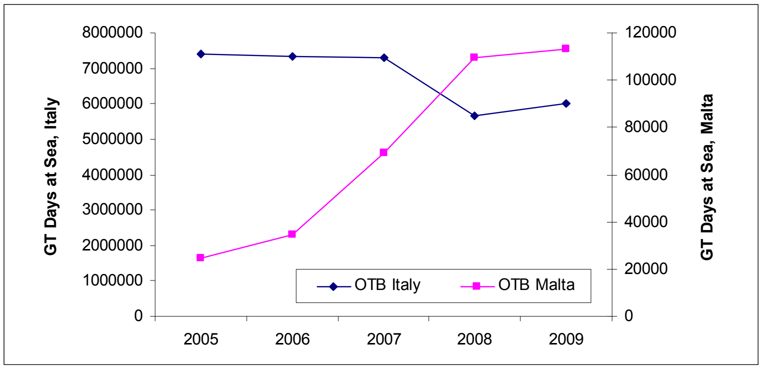


Figure 6.11.2.3.3.1. Bottom otter trawl fishing effort recorded in 2005-2009 in GSAs 15 and 16.

6.11.3 Scientific surveys

6.11.3.1 MEDITS

6.11.3.1.1 Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In order to collect fisheries independent data, which is a requirement of the EU DCF (Council Regulation 199/2008, Commission Regulation 665/2008, Commission Decision EC 949/2008 and Commission Decision 93/2010), the MEDITS international trawl survey is carried out in GSAs 15 and 16 on an annual basis. The following number of hauls was reported per depth stratum in 1994-2009 (GSA 16) and 2002-2009 (GSA 15):

Tab. 6.11.3.1.1.1. Number of hauls per year and depth stratum in GSA 16, 1994-2009.

Depth (m)	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
10-50	4	4	4	4	4	4	4	4
50-100	8	8	8	8	8	8	7	8
100-200	4	4	4	4	5	5	6	5
200-500	10	11	11	12	11	11	11	11
500-800	10	14	14	13	14	14	14	14
Depth (m)	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
10-50	7	7	7	10	10	11	11	11
50-100	11	12	12	20	22	23	23	23
100-200	10	8	9	18	19	21	21	21
200-500	19	18	19	28	31	27	27	27
500-800	19	20	19	32	33	38	38	38

Tab. 6.11.3.1.1.2. Number of hauls per year and depth stratum in GSA 15, 2002-2009.

Depth (m)	2002	2003	2004	2005	2006	2007	2008	2009
10-50	1	1	2	1	1	0	0	0
50-100	5	5	4	5	5	12	6	6
100-200	13	13	13	13	13	12	13	14
200-500	10	10	10	9	10	4	9	10
500-800	16	16	15	17	16	17	17	15

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). A limited number of obvious data errors were corrected and catches by haul were standardized to 60 minutes haul duration. Only hauls noted as valid were used, including stations with no catches of hake, red mullet or pink shrimp (i.e. zero catches were included).

The abundance and biomass indices were subsequently calculated by stratified means (Cochran, 1953; Saville, 1977). This implies weighing average values of the individual standardized catches as well as the variation of each stratum by the respective stratum area:

$Yst = \Sigma (Yi*Ai) / A$ $V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:

A = total survey area
Ai = area of the i-th stratum
si = standard deviation of the i-th stratum
ni = number of valid hauls of the i-th stratum
n = number of hauls in the GSA
Yi = mean of the i-th stratum
Yst = stratified mean abundance
V(Yst) = variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t (student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions about the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien *et al.* 2004).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

6.11.3.1.2 Geographical distribution patterns

According to Garofalo et al. (2003) most of the biomass of thorn back ray was located offshore in the central part of the Strait of Sicily, south of Malta. Sparse catches of *R. clavata* were recorded in the central and eastern part of the Strait on the Sicilian side. Moreover, on the Adventure Bank this species was restricted to the western side.

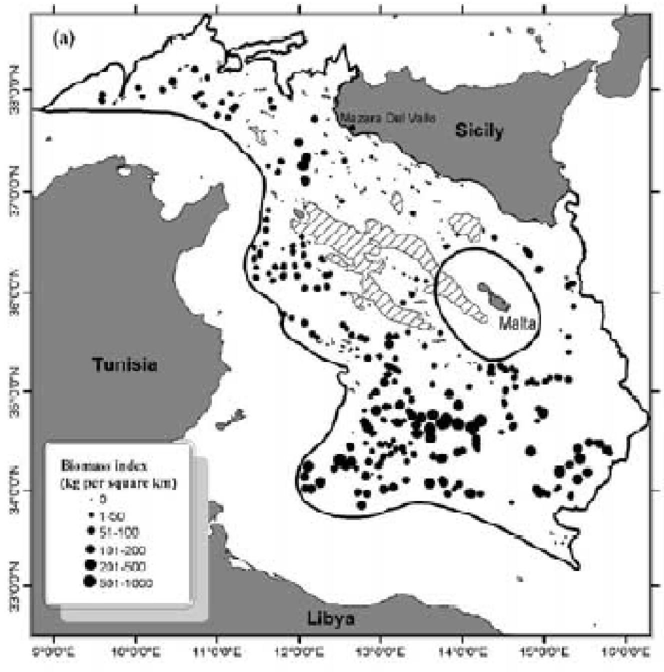


Figure 6.11.3.1.2.1 Distribution maps of *Raja clavata*, in the Strait of Sicily in the period 1997–2001. Circle radius for each value is proportional to biomass index (from Garofalo et al., 2003).

According to Camilleri et al. (2008), in the GSA 15 the species is distributed along a NW/SE axis. Abundances recorded during the MEDITS surveys are two-times higher than those of the GRUND surveys.

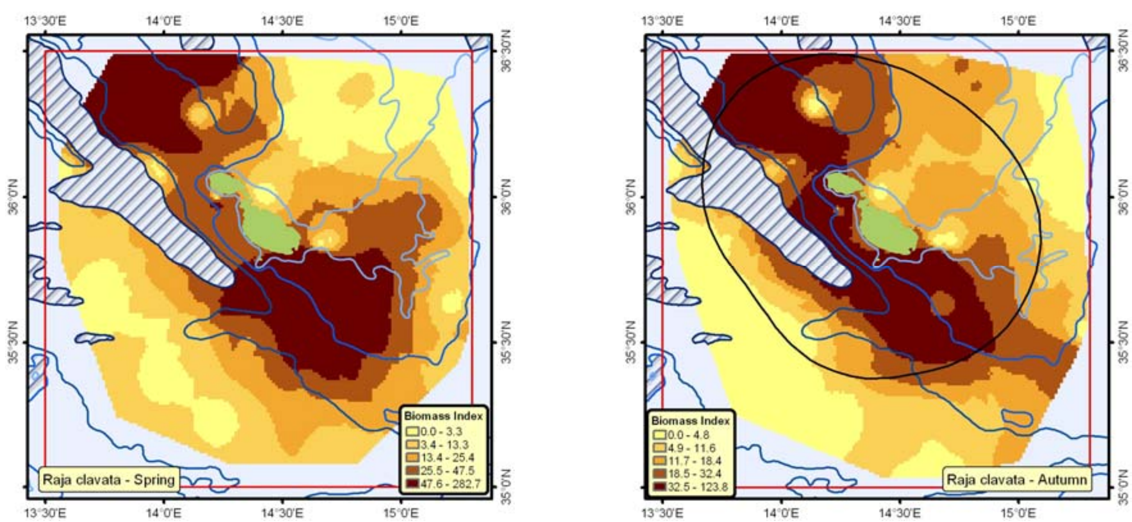


Figure 6.11.3.1.2.2 Isopleths of *Raja clavata* biomass index, averaged over 1993 and 1994, for spring and autumn in GSA 15 (from Camilleri et al., 2008).

The highest biomasses recorded during MEDITS are concentrated in two places to the southeast and to the northwest of the Maltese Islands, both characterized by muddy bottoms. GRUND biomasses show a similar pattern. Conversely, there are no concentrations on the similar bottoms to the northeast.

Recruits are concentrated south of Gozo according to the MEDITS surveys, whereas they are northwest of Gozo according to the GRUND surveys. The recruitment of this species seems limited to the edge of the continental shelf, whereas the adults have a wider distribution on both shelf and slope muddy bottoms.

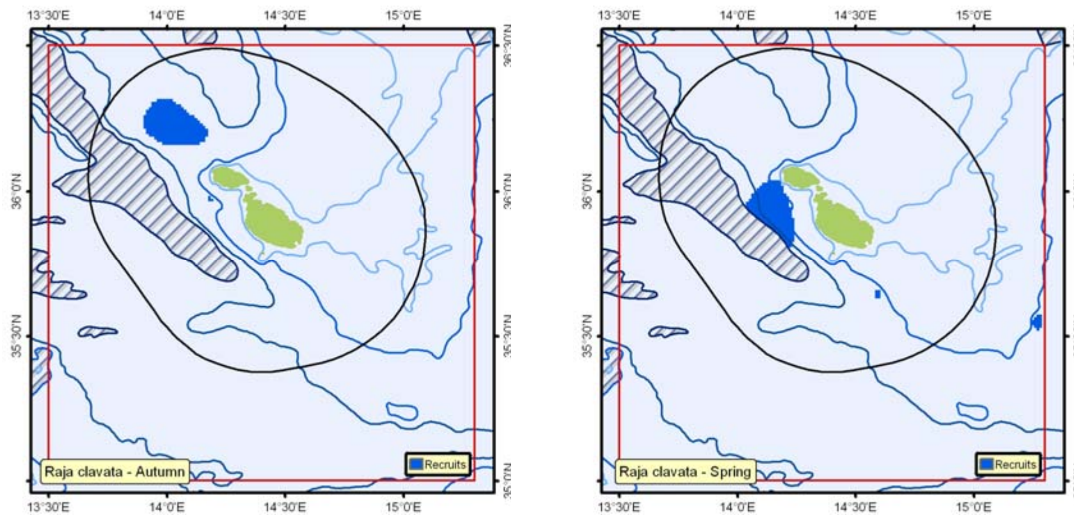


Figure 6.11.3.1.2.3 Stability areas of the density index of recruits of *Raja clavata* for spring and autumn in GSA 15 (from Camilleri et al., 2008).

6.11.3.1.3 *Trends in abundance and biomass*

Biomass indices derived from scientific surveys in spring-summer (MEDITS) in the whole investigated area (GSA 15 and 16). An increasing trend is occurring.

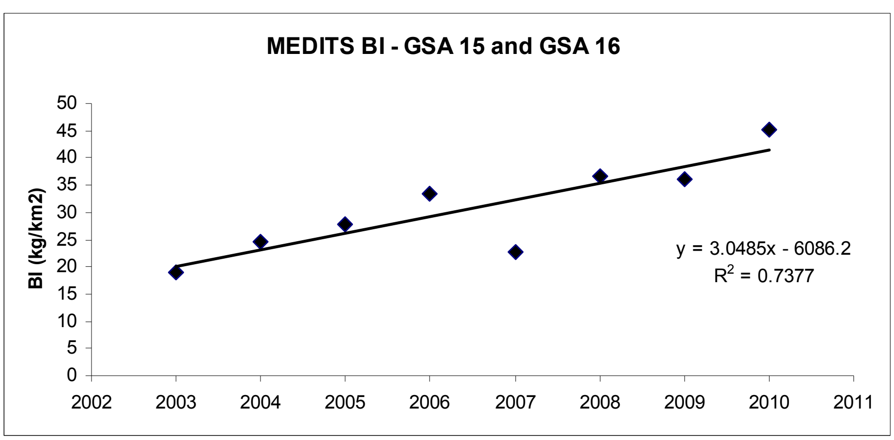


Figure 6.11.3.1.3.1 Mean biomass indices of *R. clavata* in the northern sector of the Strait of Sicily (GSA 15 + 16).

Biomass indices derived from scientific surveys in spring-summer (MEDITS) and autumn (GRUND; GSA 16 only). Both the GRUND and MEDITS BI showed an increasing trend.

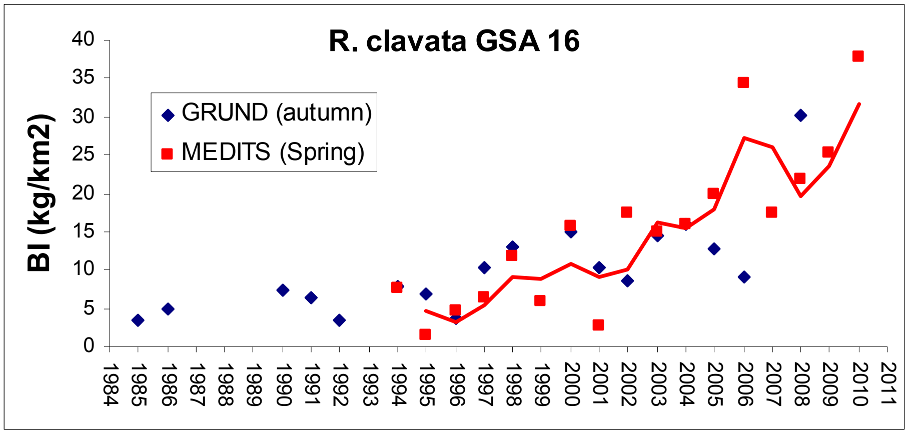


Figure 6.11.3.1.3.2 Biomass indices derived from scientific surveys in spring-summer (MEDITS) and autumn (GRUND).

6.11.3.1.4 Trends in abundance by length or age

Fig. 6.11.3.1.4.1-3 displays the MEDITS abundance indices by size in 1994-2010 for GSA 16, and Fig. 6.11.3.1.4.4-5 the MEDITS abundance indices by size in 2002-2010 for GSA 15, respectively.

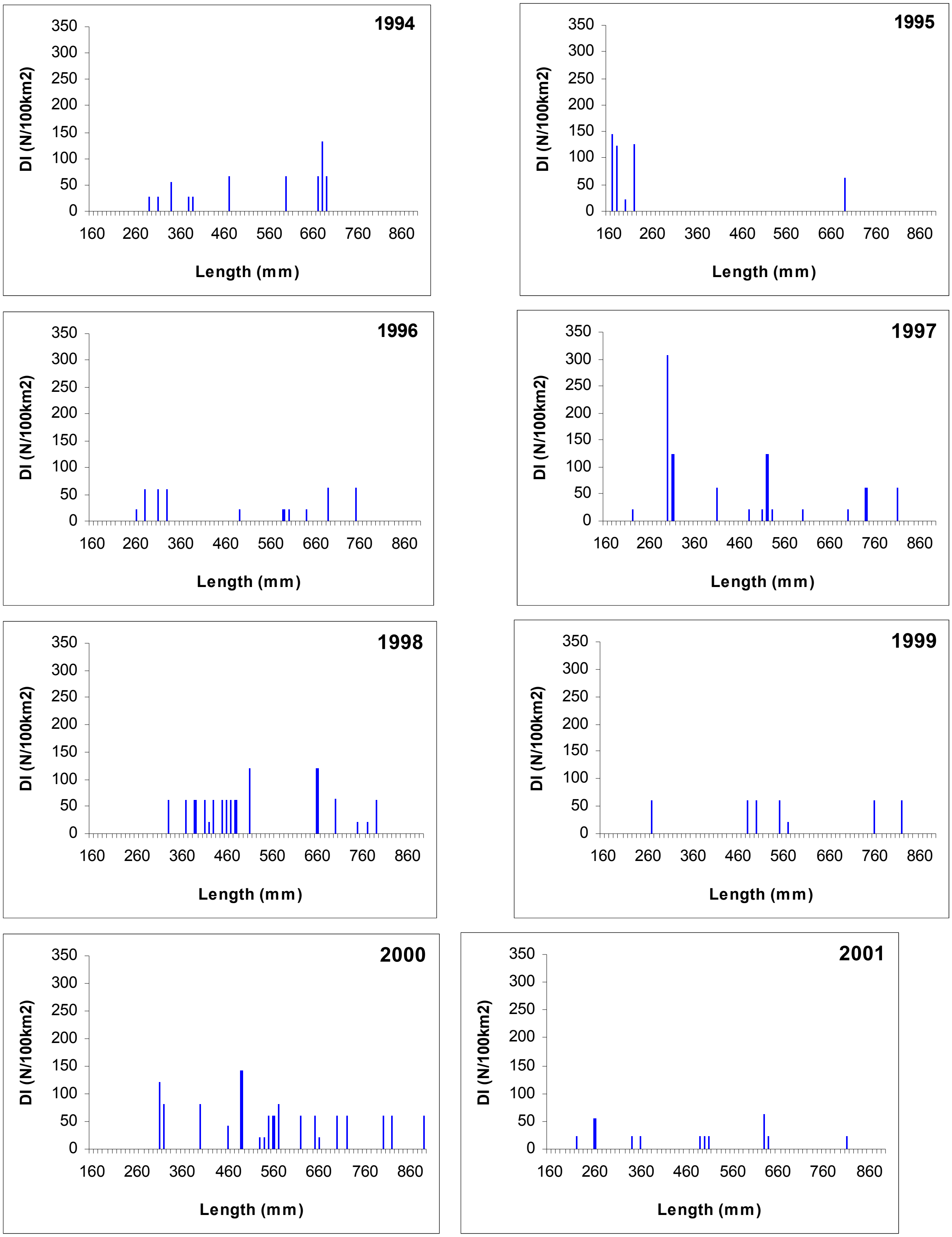


Fig. 6.11.3.1.4.1. MEDITS abundance indices by size in 1994-2001 for GSA 16.

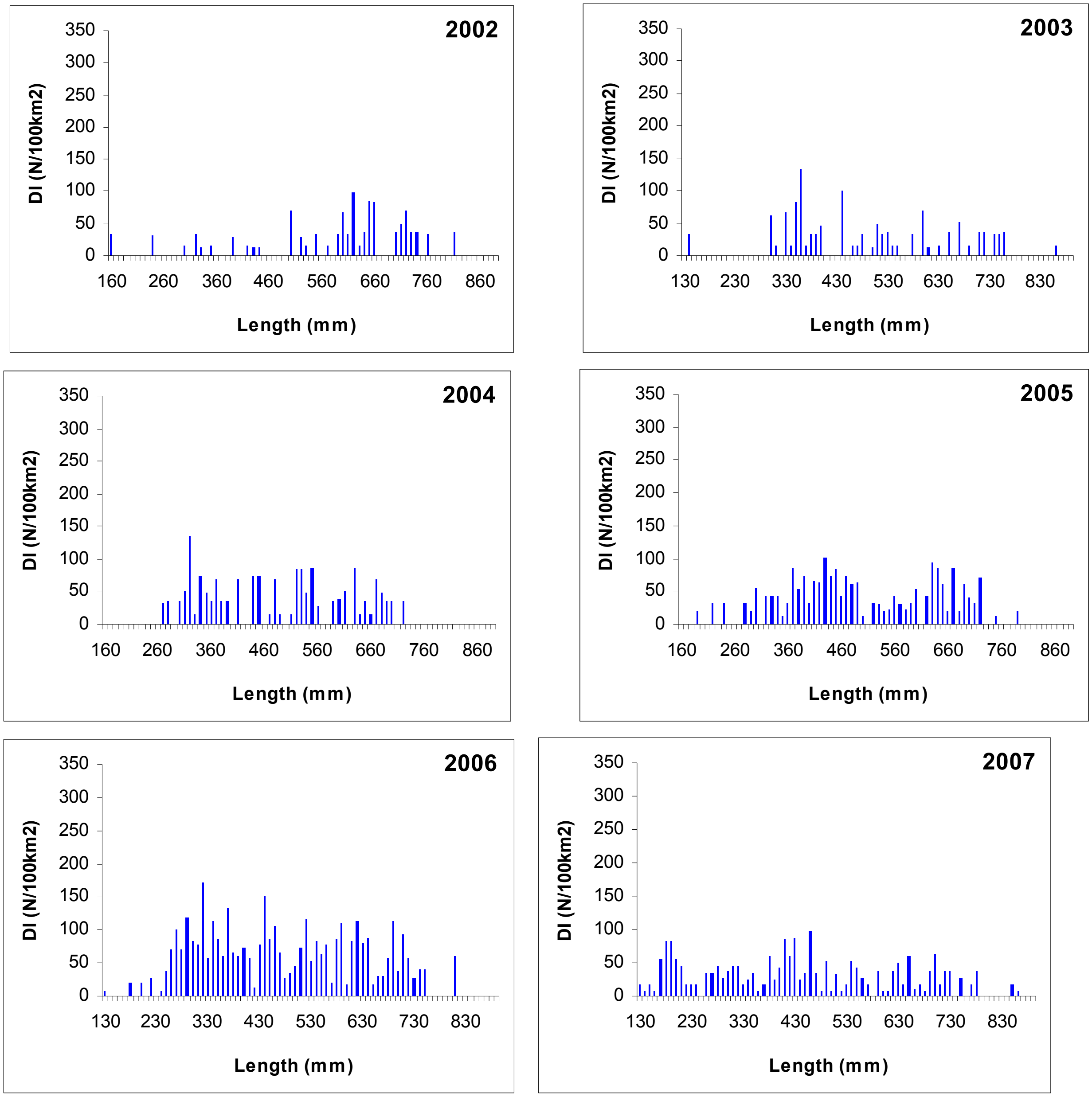


Fig. 6.11.3.1.4.2. MEDITS abundance indices by size in 2002-2007 for GSA 16.

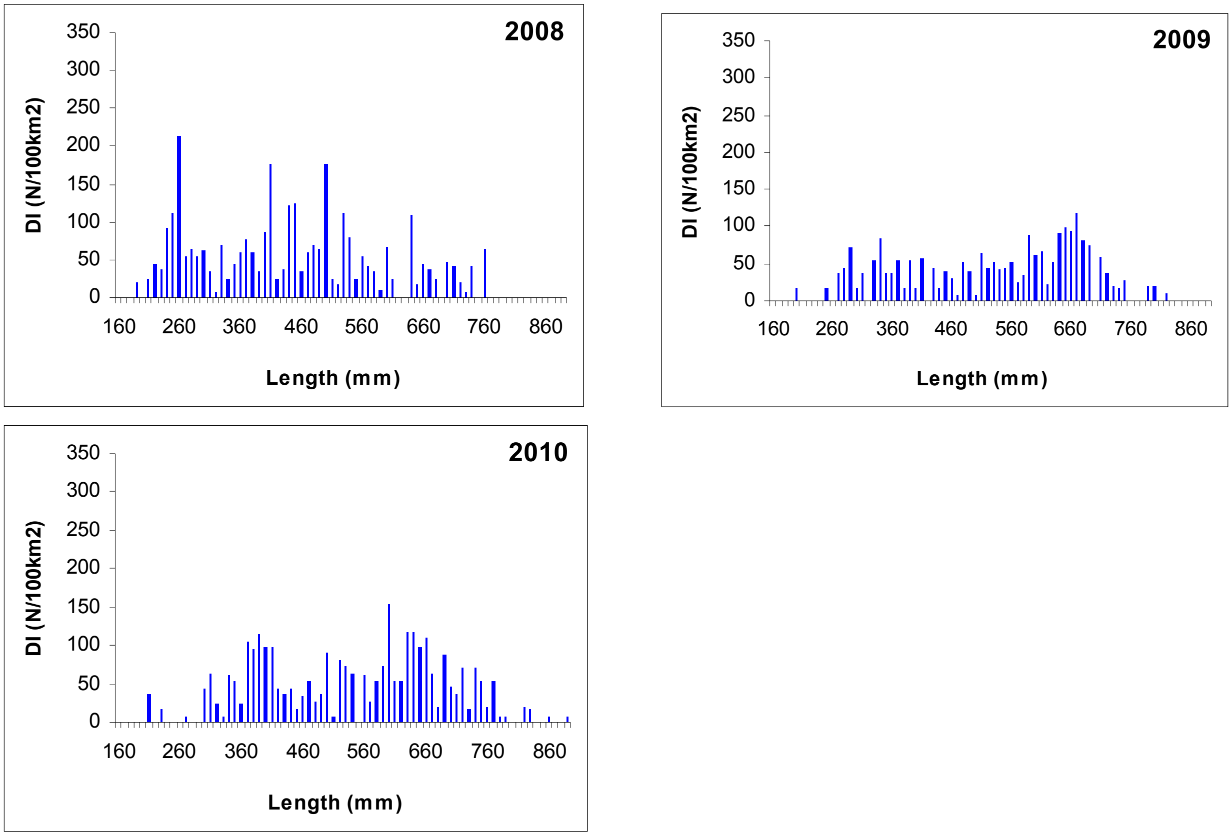


Fig. 6.11.3.1.4.3. MEDITS abundance indices by size in 2008-2010 for GSA 16.

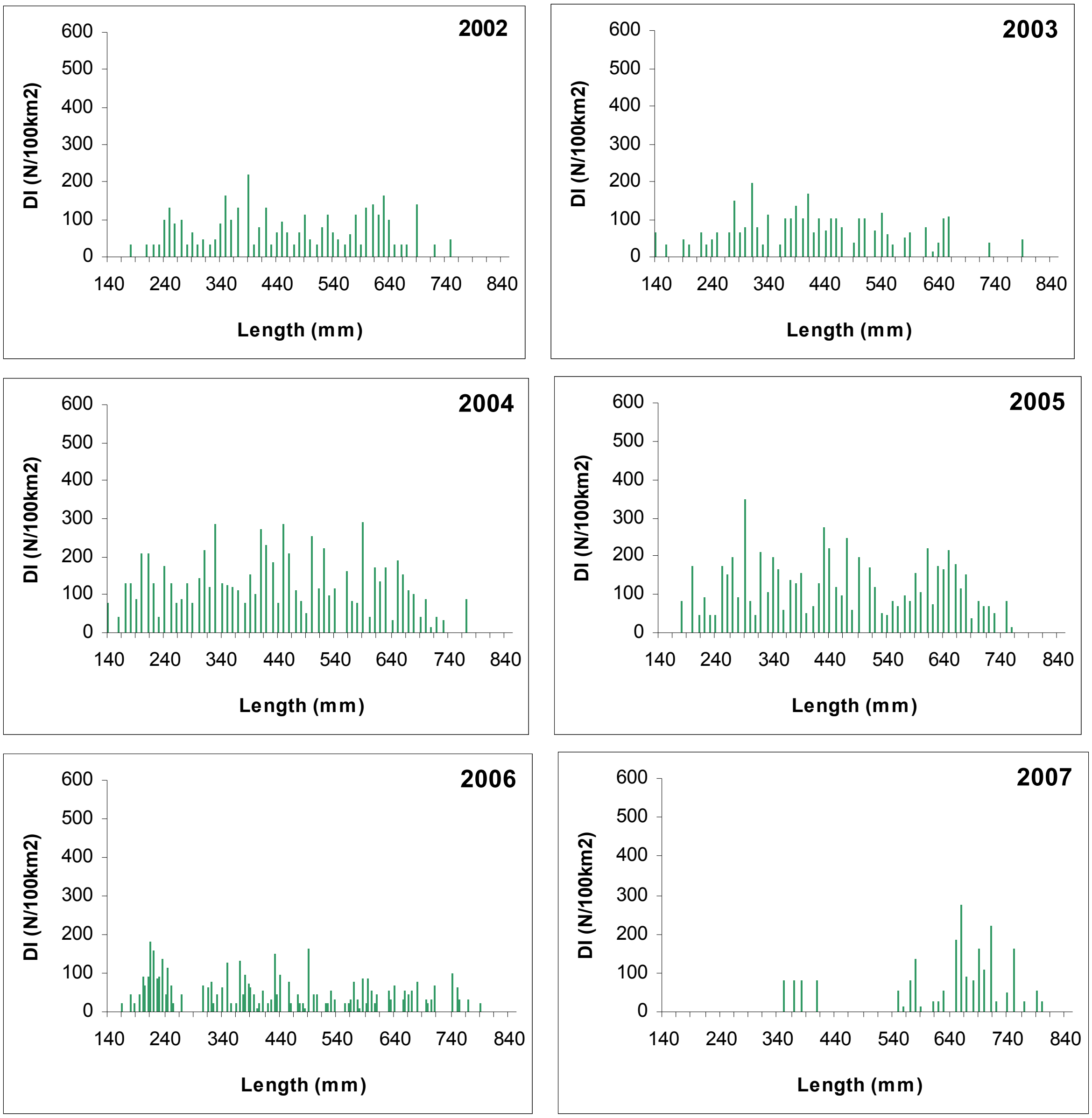


Fig. 6.11.3.1.4.4. MEDITS abundance indices by size in 2002-2007 for GSA 15.

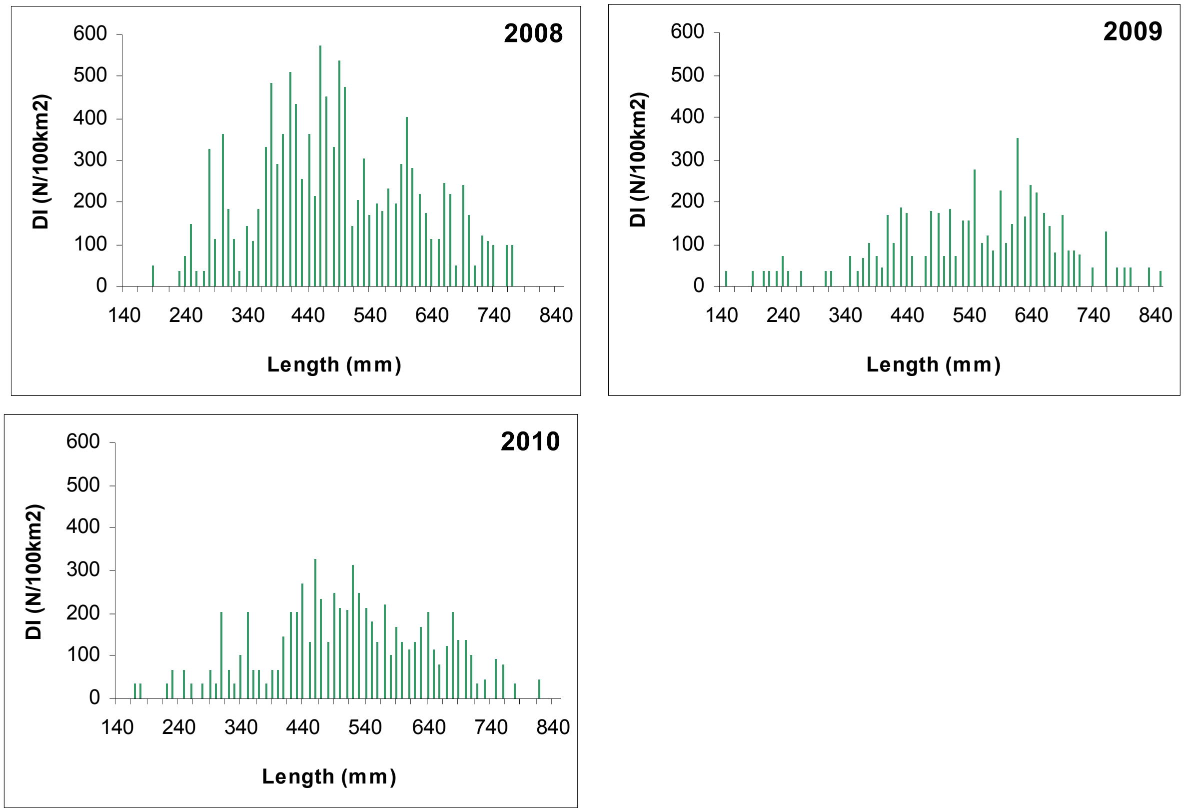


Fig. 6.11.3.1.4.5. MEDITS abundance indices by size in 2008-2010 for GSA 15.

Fig. XX Standardised MEDITS length frequency distributions of *R. clavata* recorded in GSA 15 in 2002-2010.

6.11.3.1.5 Trends in growth

No information was been documented.

6.11.3.1.6 Trends in maturity

No information was been documented.

6.11.4 Assessments of historic stock parameters

6.11.4.1 Method 1: Catch curve analysis

6.11.4.1.1 Justification

A long time series of survey data was available to EWG 11-05, so an estimation of fishing mortality based on a catch curve analysis under steady state assumption of this data was carried out. Total mortality rates were estimated by using both single year and average over four year abundances. This last choice is considered a best approximation of steady state assumption. The mean F was estimated as Z-M.

6.11.4.1.2 Input parameters

Standardised MEDITS LFDs by sex were ‘age sliced’ and the software package LFDA 5 (Kirkwood *et al*., 2001).

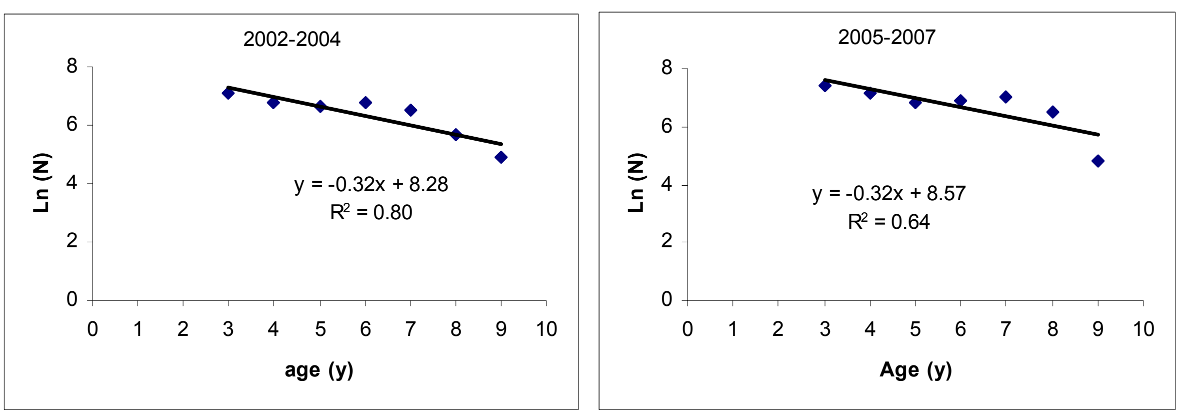
Table 6.11.4.1.2.1. Results of age spicing carried out based on length frequency distributions of MEDITS survey data (2002-2010) used as input data for the catch curve analysis. Only final results for males and females and GSA 15 and 16 combined are shown.

Age in year	2002	2003	2004	2005	2006	2007	2008	2009	2010
0	6	72	53	0	13	52	0	9	0
1	163	89	314	285	465	302	456	105	111
2	216	386	658	568	793	249	724	312	378
3	256	442	550	655	635	349	1204	452	753
4	169	257	471	546	548	211	1207	340	654
5	163	165	429	293	467	191	656	515	601
6	393	165	318	374	407	180	489	550	585
7	216	102	356	450	342	335	366	546	507
8	135	82	81	179	278	218	271	221	313
9	52	69	13	15	31	79	47	82	88
10	17	0	0	0	36	8	0	27	38
11+	0	11	0	0	3	12	0	0	8

Taking into account the availability of male and female growth parameters, age slicing was done keeping sexes separate. Results were subsequently combined to obtain age frequency distributions for the entire population.

6.11.4.1.3 Results

Total mortality (Z) estimations remained stable around 0.32 – 0.34.



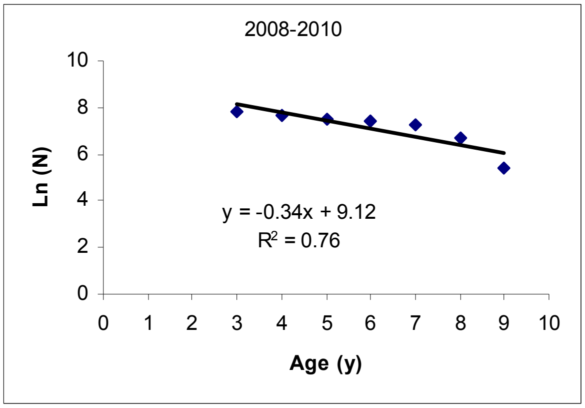


Figure 6.11.4.1.3.1. Z estimation from catch curve analysis based on MEDITS survey data 2002-2004, 2005-2007, and 2008-2010 combined; x axis refers to age, y axis refers to natural log of MEDITS DI by age; analysis was carried out for ages 3-9.

6.11.1 Long term prediction

6.11.1.1 Justification

No analyses performed by EWG 11-05.

6.11.1.2 Input parameters

Not data available.

6.11.1.3 Results

No results obtained.

6.11.2 Data quality

The major shortfall is the lack of relevant size/age compositions from fisheries landings and discards.

6.11.1 Scientific advice

6.11.1.1 Short term considerations

6.11.1.1.1 State of the stock size

Both the GRUND and MEDITS surveys indicate consistent increasing trends in stock size indices since 2033 in both GSAs 15 and 16. In the absence of proposed precautionary reference points and absolute stock size estimations EWG 11-05 is unable to fully evaluate the state of the stock size.

6.11.1.1.2 State of recruitment

No analysis undertaken.

6.11.1.1.3 State of exploitation

EWG 11-05 is unable to advise on specific management reference points consistent with high long term yields.

In the absence of proposed management reference points and given the data availability and analysis undertaken, EWG 11-05 is unable to conclude on the exploitation status of the stock and provide consistent advice.

6.12 Stock assessment of common sole in GSA 17

6.12.1 Stock identification and biological features

6.12.1.1 Stock Identification

Tagging experiments carried out on common sole in the northern Adriatic Sea, using the traditional mark-and-recapture procedure, showed that all individuals were re-captured within the sub-basin (Pagotto *et al.*, 1979). Local currents, eddies and marked differences of oceanographic features of this sub-basin with respect to those of southern Adriatic and Ionian Sea (Artegiani *et al.*, 1997) may prevent a high rate of exchange of adult spawners and the mixing of planktonic larval stages from nursery areas of adjacent basins (Magoulas *et al.*, 1996). Guarniero *et al.* (2002), taking into account differences of sole specimens from five different central Mediterranean areas in the control region sequence marker, suggested that two near-panmictic populations of common sole could exist in the Adriatic Sea. The former population would inhabit the entire GSA 17 (northern Adriatic Sea). The second unit seems to be spread along the Albanian coasts (eastern part of the GSA 18). The hydrogeographical features of this semi-enclosed basin might support the overall pattern of differentiation of the Adriatic common soles.

The northern Adriatic Sea has a high geographical homogeneity, with a wide continental shelf and eutrophic shallow-waters. The southern Adriatic in contrast is characterized by narrow continental shelves and a marked, steep continental slope (1200 m deep; Adriamed, 2000). This deep canyon could represent a significant geographical barrier for *S. solea*.

On these bases, different actions for fishery management should be proposed for the Adriatic common sole stocks in GSA 17 and GSA 18. In the former area the stock is shared among Italy, Slovenia and Croatia, while in the latter one seems to be shared only between Montenegro and Albania.

S. solea is a demersal and sedentary species, living on sandy and muddy bottoms (Tortonese, 1975, Fisher *et al.*, 1987, Jardas, 1996). Although Jardas, (1996) stated that the species is distributed from coastal waters to 250 m depth, it was exclusively caught up to 100 m during the expedition MEDITS (1996-1998) (Vrgoč, 2000).

Common sole usually feeds on small quantities of prey (Sà *et al.*, 2003). This suggests a high evacuation rate between the stomach and the intestine, and lack of digestion in the stomach (Lagardère, 1987). The fish feeding activity occurs night and day and for the remaining time usually lives embedded in the seabed. In the Adriatic Sea food items mostly include invertebrates and small fish (Tortonese, 1975; Fisher *et al.*, 1987; Jardas, 1996). Within the framework of SoleMon project, a study of gut content using carbon- and nitrogen stable isotopes along the sole food web was carried out, indicating that *S. solea* diet depends on both the geographical position and the size of individuals, which change their feeding habit with the increase of the age. This could be related to the fact that the sole selects its preys basing on both their energetic value and the energy spent to catch them. The choice of sole would be also related to prey abundance, as postulated by the "*optimal foraging theory*" (MacArthur and Pianka, 1966) and observed in other flatfish (Hinz *et al.*, 2005). Stergiou and Karpouzi (2002) found that in the Mediterranean Sea the sole increases its trophic level with the increasing of the size, reaching values of around 3.4. The mean trophic level estimated from the SoleMon project data through the stable isotope analysis was slightly higher (3.9), but similar to the value obtained in a study carried out in the Rodano river mouth (Darnaude, 2005).

6.12.1.2 Growth

In the Adriatic sea, growth analyses on this species have been made using otoliths, scales and tagging experiments. A huge variation in the growth rate was noted: some specimens had grown 2 cm in one month, while others, of the same age group, for the same size increase needed a whole year (Piccinetti and Giovanardi, 1984; Tab. 6.12.1.2.1). Von Bertalanffy growth equation parameters have been calculated using various methods. Within the framework of SoleMon project, growth parameters of sole were estimated through the length-frequenzy distributions obtained from surveys (Fig. 6.12.1.2.1; Tab. 6.12.1.2.2).

Tab. 6.12.1.2.1. Growth rates of *S. solea* from different studies. (TL, cm; age, yr).

Author	**Sex**	**Age**					
		1	**2**	**3**	**4**	**5**	**6**
Ghirardelli (1959)	M+F	16.8	21.4	23.9	25.6	33.1	-
Piccinetti and Giovanardi (1984)	M+F	18-20	21-30	-	-	-	-
Vallisneri *et al*. (2000)	F	20	25	29	32	34	37

Tab. 6.12.1.2.2. Von Bertalanffy parameters of *S. solea* estimated in different studies. *(k, yr^{-1}; t_0, yr).

Author	**Sex**	**W_8(g)**	**L_8 (cm)**	**k ($month^{-1}$)**	**t_0 (month)**
Piccinetti and Giovanardi (1984)	M+F	-	40.10	0.68*	-
Froglia and Giannetti (1985)	M+F	-	38.25	0.041	-3.57
Froglia and Giannetti (1986)	M	323	23.20	0.069	-1.66
	F	562	37.87	0.042	-5.36
	M+F	576	38.25	0.041	-3.57
Fabi *et al.* (2009)	M+F	-	39.60	0.44*	-0.46*

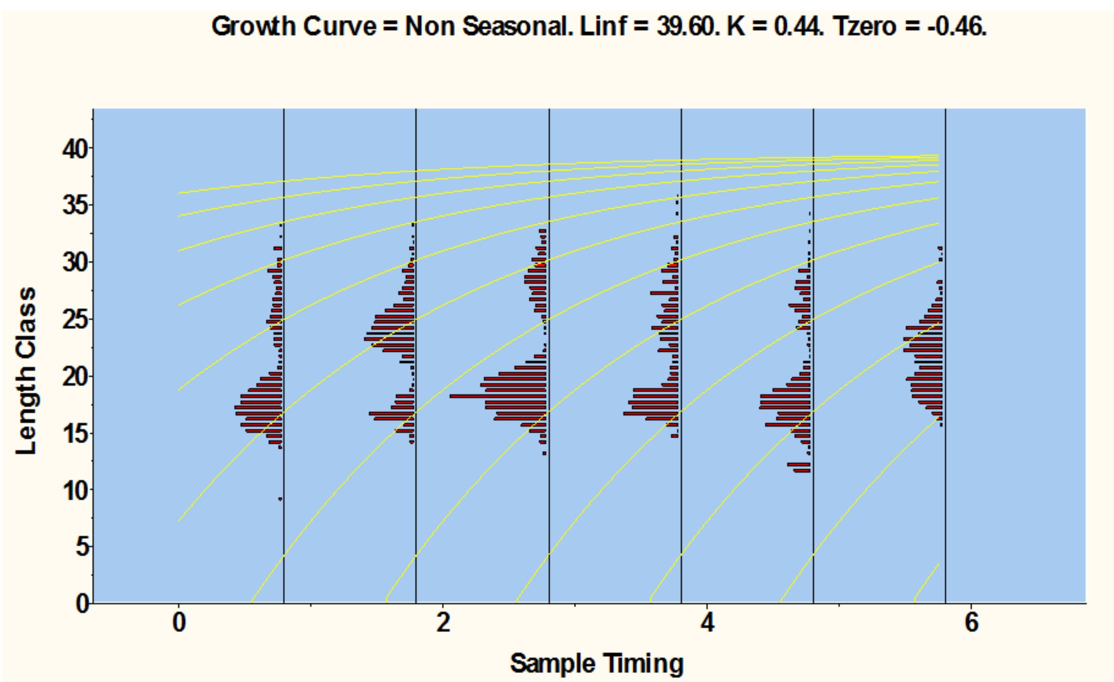


Fig. 6.12.1.2.1 Von Bertalanffy growth functions for sole in the GSA 17, based on SoleMon length frequency distributions (2005-2010).

6.12.1.3 Maturity

In the Mediterranean Sea, the reproduction of common sole occurs from December to May (Bini (1968-70), Tortonese, 1975, Fisher *et al*., 1987). Within the framework of SoleMon project, it has been observed that in the central and northern Adriatic Sea the reproduction takes place from November to March. Data on the spatial distribution of spawners provided by the project show a higher concentration of reproducers outside the western coast of Istria (Fabi *et al.*, 2009).

Length at first maturity is 25 cm (Fisher *et al.*, 1987; Jardas, 1996; Vallisneri *et al.*, 2000); this value has been estimated at 25.8 using data from SoleMon project. Females having a weight of 300 g produce about 150000 eggs, while those weighting 400 g produce about 250000 eggs (Piccinetti and Giovanardi, 1984); eggs are pelagic. The male-female ratio is approximately 1:1 (Piccinetti and Giovanardi, 1984; Fabi *et al.*, 2009).

Hatching occurs after eight days and the larvae measures 3 to 4 mm TL (Tortonese, 1975). Eye migration starts at 7 mm TL and ends at 10-11 mm TL. Benthic life begins after seven or eight weeks (15 mm) in coastal and brackish waters (Bini (1968-70); Fabi *et al*., 2009).

6.12.2 Fisheries

6.12.2.1 General description of fisheries

The common sole is a very important commercial species in the central and northern Adriatic Sea (Ghirardelli, 1959; Piccinetti, 1967; Jardas, 1996; Vallisneri *et al.*, 2000; Fabi *et al.*, 2009). Italian *rapido* trawlers exploit this resource providing more than 80% of landings in the area comprised from San Benedetto del Tronto and Trieste, as observed in the framework of the SoleMon project. Sole is also a target species of the Italian and Croatian set netters, while it represents an accessory species for otter trawlers.

From censuses carried out at the landing sites, the Italian *rapido* trawl fleet operating in GSA 17 (TBB) was made of 155 vessels in 2005 and 124 vessels in 2006 ranging from 9 to 30 m in vessel length, GRT ranged from 4 to 100 and the engine power from 60 to 1000 HP. Each vessel can tow from 2 to 4 *rapido* trawls depending on its dimensions. The *rapido* trawl is a gear used specifically for catching flatfish and other benthic species (e.g. cuttlefish, mantis shrimp, etc.). It resembles a toothed beam-trawl and is made of an iron frame provided with 3-5 skids and a toothed bar on its lower side. These gears are usually towed at a greater speed (up to 10-13 km h^{-1}) in comparison to the otter trawl nets; this is the reason of the name "*rapido*", the Italian word for "fast". The mesh opening of the codend used by the Italian *rapido* trawlers is larger (48 mm stretched or more) than the legal one. The main Italian *rapido* trawl fleets of GSA 17 are sited in the following harbors: Ancona, Rimini and Chioggia.

The Italian artisanal fleet in GSA 17, according to SoleMon project data (end of 2006), accounted for 469 vessels widespread in many harbors along the coast. They use gill net or trammel net especially from spring to fall and target small and medium sized sole (usually smaller than 25 cm TL).

6.12.2.2 Management regulations applicable in 2010 and 2011

- Fishing closure for trawling: 30 days in summer.
- Minimum landing sizes: EC regulation 1967/2006: 20 cm TL for sole.
- Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets will be replaced with a cod end with 40 mm (stretched) square meshes or a cod end with 50 mm (stretched) diamond meshes.
- Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast.

6.12.2.3 Catches

6.12.2.3.1 Landings

From 2005 to 2009 total landings of sole of GSA 17 fluctuated between 1,673 to about 2,184 tons and although the time series is short, the general shape suggests stability over time (Fig. 6.122.2.3.1.1).

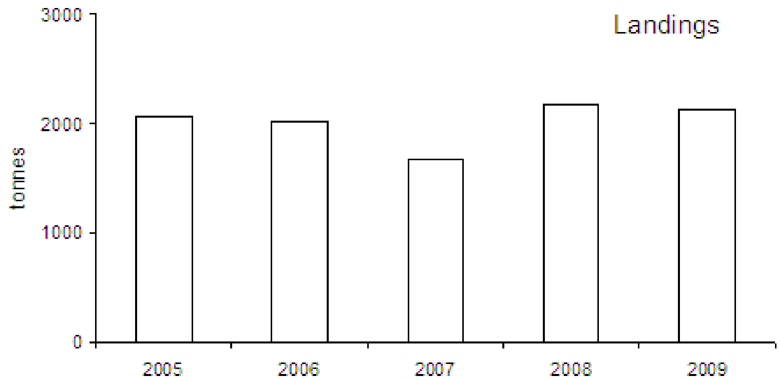


Fig. 6.122.2.3.1.1 Landings of sole (all gears) in the GSA 17, from 2005 to 2009.

Rapido trawl landings were traditionally dominated by small sized specimens; they are basically composed by 1 and 2 year old individuals. Set net fishery lands mostly the same portion of the population, while the otter trawl fishery, exploiting wider fishing grounds, shows a different size distribution of the landings.

Tab. 6.12.2.3.1.1 Landings (t) 2004-2009 as reported through the official DCF data call.

SPECIES	AREA	COUNTRY	GEAR	2004	2005	2006	2007	2008	2009
SOL	17	ITA	FPO	4.4	3.1	0.5	53.1	0.3	
SOL	17	ITA	FYK	0.6	0.2	0.1		0.1	0.9
SOL	17	ITA	GNS	329.7	614.3	716.7	466.3	410.6	510.0
SOL	17	ITA	GTR	133.5	85.9	52.4	54.2	44.3	63.7
SOL	17	ITA	OTB	453.7	558.8	248.0	226.1	199.3	284.1
SOL	17	ITA	OTM			0.3			
SOL	17	ITA	PS	0.1					
SOL	17	ITA	PTM	0.2	0.1		1.0		
SOL	17	ITA	TBB	398.7	373.1	863.1	691.6	576.1	849.5
SOL	17	ITA		30.9	26.8	9.8	0.2	0.1	0.1
SOL	17	SVN	FPO			0.1	0.1		
SOL	17	SVN	FYK		0.2				
SOL	17	SVN	GND			0.1		0.1	
SOL	17	SVN	GNS		1.9	2.6	3.9	2.7	2.1
SOL	17	SVN	GTR		10.3	7.8	13.1	10.8	18.4
SOL	17	SVN	LHP-LHM						0.1
SOL	17	SVN	LLS			0.1			
SOL	17	SVN	OTB		0.4	0.6	0.4	0.7	0.5
SOL	17	SVN		1351.7	1675.1	1902.0	1509.8	1244.9	1729.3

6.12.2.3.2 Discards

Several projects carried out in a portion of GSA17 highlighted that the discard of sole both by *rapido* trawl and set net fisheries is negligible (Fabi *et al.*, 2002; Fabi & Sartor, 2002) as the damaged specimens are also commercialized, even though at a lower price.

6.12.2.3.3 Fishing effort

From SoleMon project data, the overall Italian fleet exploiting sole in the GSA 17 is made up by around 1,300 vessels (rapido trawlers, set netters, otter trawlers; Tab. 6.12.2.3.3.1). DCF data are shown in Table 6.12.2.3.3.2.

Tab. 6.12.2.3.3.1 Number of vessels x day exploiting sole in GSA 17 (SoleMon project data).

Year	**2005**	**2006**	**2007**	**2008**	**2009**
Effort (vessels x days)	152,182	122,669	108,830	116,860	134,430

The trends of the fishing effort of Ancona and Rimini *rapido* trawl fleets have been analyzed over the years 1996-2008 and 2005-2008 respectively. The fishing effort of Ancona fleet increased from 1996 to 2003 and declined in the subsequent years. A similar decreasing pattern also occurred for the Rimini fleet in the last four years (Fig. 6.12.2.3.3.1).

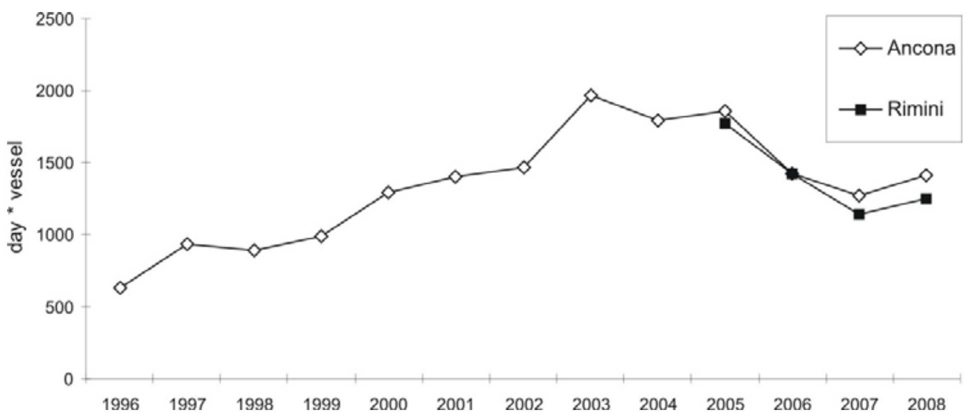


Fig. 6.12.2.3.3.1 Trends of effort (day*vessel) by Ancona and Rimini rapido trawl fleets.

Tab. 6.12.2.3.3.2 Fishing effort GT*days as reported though the official DCF data call.

COUNTRY	GEAR	2004	2005	2006	2007	2008	2009
ITA	DRB	860883	709984		1049547	910490	681776
ITA	FPO	63066	33179	85425	77380	64267	73359
ITA	FYK	21527	18801	49347	64066	41125	52756
ITA	GND		67				
ITA	GNS	228554	263277	214084	156442	131751	173717
ITA	GTR	126229	78273	77829	100690	57354	63046
ITA	LLD	10842	16679	13926	14162	4468	5264
ITA	LLS			38	35		
ITA	none			147946	97972	77386	92235
ITA	OTB	3927177	5576157	4334314	4213161	3732588	3617158
ITA	OTM	1143	2278	3372			
ITA	PS	119873	98758	149842	246808	136216	208168
ITA	PTM	1163694	1517993	1797242	1874837	1125353	1338590
ITA	TBB	991931	748668	1210675	992786	845693	931859
ITA		211740	216421				
SVN	FPO		249	260	238	1654	2454
SVN	FYK		50	142	130	2	116
SVN	GND		112	34	92	34	10
SVN	GNS		3538	3331	5332	6295	5754
SVN	GTR		4307	3825	9009	9279	9470
SVN	LHP		4		2	4	5
SVN	LLS		22	162	20	14	75
SVN	OTB		9966	13505	19467	19785	19649
SVN	OTM					8	187
SVN	PS		3296	3832	3098	3064	4344
SVN	PTM		26184	23876	28740	18172	26582

6.12.3 Scientific surveys

6.12.3.1 SoleMon

6.12.3.1.1 Methods

Eight *rapido* trawl fishing surveys were carried out in GSA 17 from 2005 to 2010: two systematic “pre-suveys” (spring and fall 2005) and four random surveys (spring and fall 2006, fall 2007-2010) stratified on the basis of depth (0-30 m, 30-50 m, 50-100m). Hauls were carried out by day using 2-4 *rapido* trawls simultaneously (stretched codend mesh size = 40.2 ± 0.83). The following number of hauls was reported per depth stratum (Tab. 5.52.3.1.1.1).

Tab. 6.12.3.1.1.1 Number of hauls per year and depth stratum in GSA 17, 2005-2010.

Depth strata	Spring 2005	Fall 2005	Spring 2006	Fall 2006	Fall 2007	Fall 2008-2010
0-30	30	30	20	35	32	39
30-50	14	12	10	20	19	17
50-100	24	15	8	8	11	11
HR islands		5	4	4		
TOTAL	68	62	42	67	62	67

Abundance and biomass indexes from *rapido* trawl surveys were computed using ATrIS software (Gramolini *et al*., 2005) which also allowed drawing GIS maps of the spatial distribution of the stock, spawning females and juveniles. Underestimation of small specimens in catches due to gear selectivity was corrected using the selective parameters given by Ferretti and Froglia (1975).

The abundance and biomass indices by GSA 17 were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum area in the GSA 17:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval:

Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the way stations with zero catches are managed, and hence assumptions over the statistical distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien *et al.*, 2004).

Length distributions represented an aggregation (sum) of all standardized length frequencies over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

6.12.3.1.2 Geographical distribution patterns

According to data collected during SoleMon surveys (Fabi *et al.*, 2009), age class 0+ aggregates inshore along the Italian coast, mostly in the area close to the Po river mouth (Fig. 6.12.3.1.2.1). Age class 1+ gradually migrates off-shore and adults concentrate in the deepest waters located at South West from Istria peninsula.

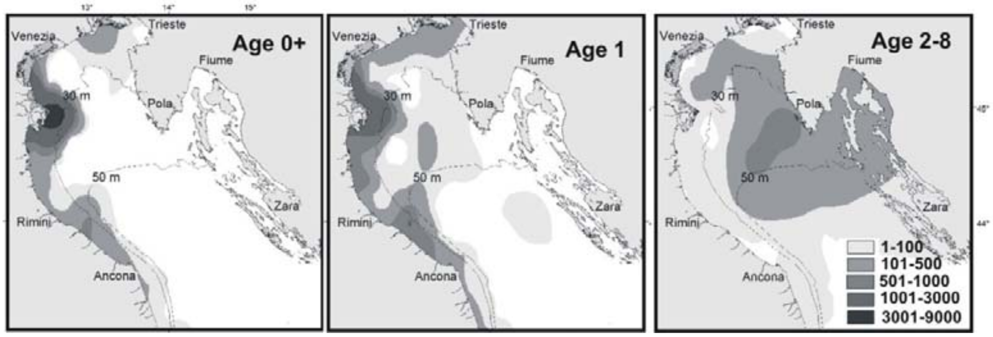


Fig. 6.12.3.1.2.1 Example of abundance indices (ind.· km^{-2}) for sole from SoleMon survey carried out in GSA 17 (fall 2007) interpolated using Kriging (Fabi *et al.*, 2009).

6.12.3.1.3 Trends in abundance and biomass

The SoleMon trawl surveys provided data either on sole total abundance and biomass as well as on important biological events (recruitment, spawning).

Fig. 6.12.3.1.3.1 shows the abundance and biomass indices of sole obtained from 2005 to 2008; slightly increasing trends occurred till fall 2007, followed by a decrease in abundance from 2008 to 2010, while biomass showed a decreasing trend till 2009 followed by an increase in 2010.

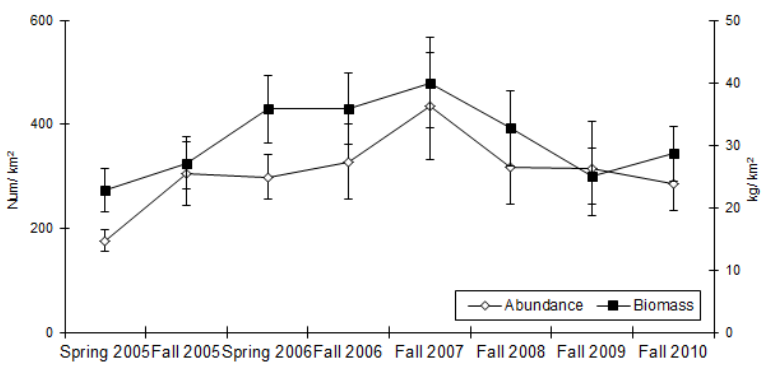


Fig. 6.12.3.1.3.1 Aabundance and biomass indices of sole obtained from SoleMon surveys.

The recruitment showed a fluctuating trend with the lowest values in 2006, 2008 and 2010 (Fig. 6.12.3.1.3.2). The number and biomass of spawners remained practically constant from 2005 to 2008 and decreased in the following period, reaching absolute lowest values in 2010 (Fig. 6.12.3.1.3.3).

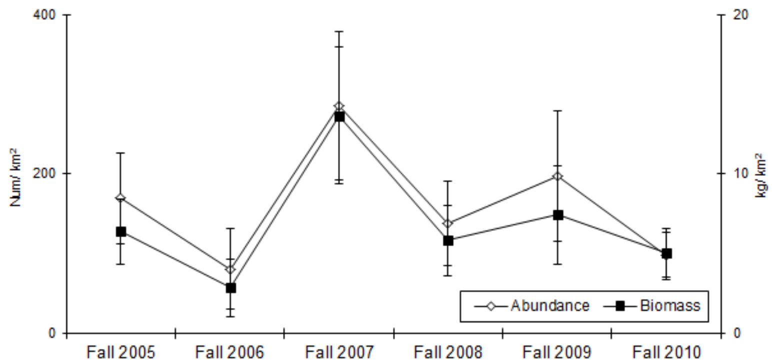


Fig. 6.12.3.1.3.2 Abundance and biomass indices of recruits of sole obtained from SoleMon surveys.

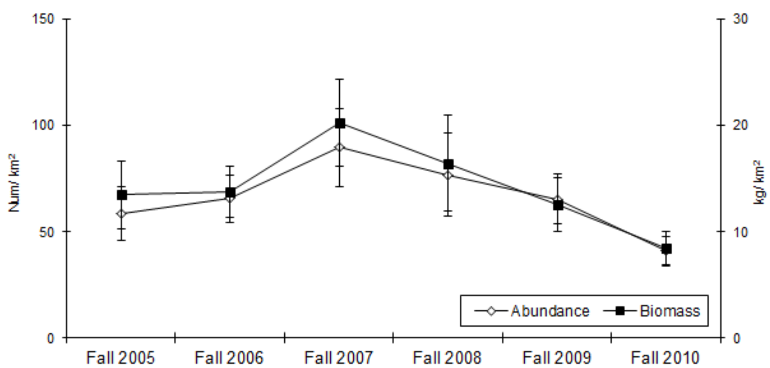


Fig. 6.12.3.1.3.3 Aabundance and biomass indices of spawners of sole obtained from SoleMon surveys.

6.12.3.1.4 Trends in abundance by length or age

Fig. 6.12.3.1.4.1 displays the stratified abundance indices obtained in the GSA 17 in the years 2005-2010.

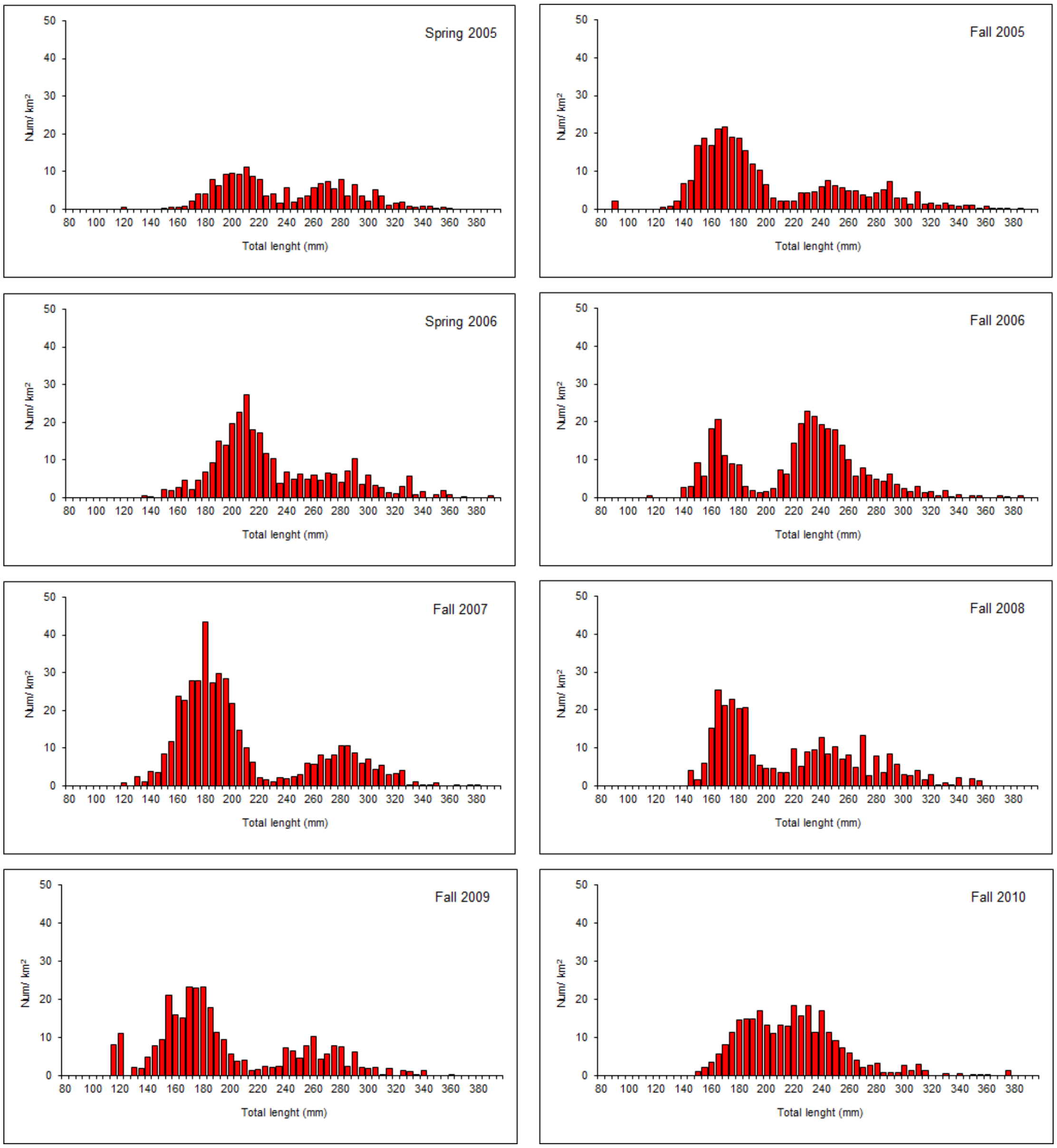


Fig. 6.12.3.1.4.1 Stratified abundance indices by size, 2005-2010.

6.12.3.1.5 Trends in growth

No information was been documented.

6.12.3.1.6 Trends in maturity

No information was been documented.

6.12.4 Assessments of historic stock parameters

Sole has been object of assessments in the GSA 17 and results are published and regularly updated in the GFCM SAC sheets and in SGMED. The assessments, often performed with different approaches, showed substantially convergent results.

The previous assessments, also the analyses performed during the WG on demersal in the framework of SAC-GFCM, were based on fishery dependent data provided by SoleMon, because DCF data were not suitable for the analyses (see SGMED-10-02). EWG 11-05 has updated the assessment carried out during the SGMED-10-02 only with 2010 survey data, because fishery dependent data from SoleMon project and DCF were not available during the meeting.

From the SGMED-10-02, the sole stock in the GSA 17 seems to be overexploited, as shown by the results of the analytical models (reference points as F_{max}, $F_{0.1}$). A growth overfishing situation was detected, with high fishing mortality on 1+ and 2+ age classes.

EWG-11-05 has updated the assessment carried out during the SGMED 10-02 only with 2010 survey data.

6.12.4.1 Method 1: Catch curve analysis

6.12.4.1.1 Justification

As described below DCF data were not suitable to perform any assessment. So length frequency distributions from SoleMon survey were utilized to calculate the annual total mortality Z. The mean Z from 2005 to 2010 was calculated and the F resulted from the difference with the mean M estimated from the vector calculated by PROBIOM.

6.12.4.1.2 Input parameters

Length frequency distributions from fall 2005 to fall 2010 from SoleMon survey and VBGF parameters reported before.
A vector of natural mortality rate at age was estimated using the PRODBIOM spread-sheet (Abella et al., 1997) and the mean value was estimated (M mean = 0.35).

6.12.4.1.3 Results

Exploitation increased from 2005 to 2007, decreased in 2008 and was constant in 2009-2010. The most recent estimate of fishing mortality is 1.23, and the average values calculated on the all period was 0.84 (Tab. 6.12.4.1.3.1; Fig. 6.12.4.1.3.1).

Tab. 6.12.4.1.3.1 Values of total mortality (Z) and fishing mortality (F) estimated from the catch curve.

	Fall 2005	Fall 2006	Fall 2007	Fall 2008	Fall 2009	Fall 2010	Mean values
Z	0.93	0.95	1.35	1.02	1.31	1.58	1.19
F	0.58	0.60	1.00	0.67	0.96	1.23	0.84

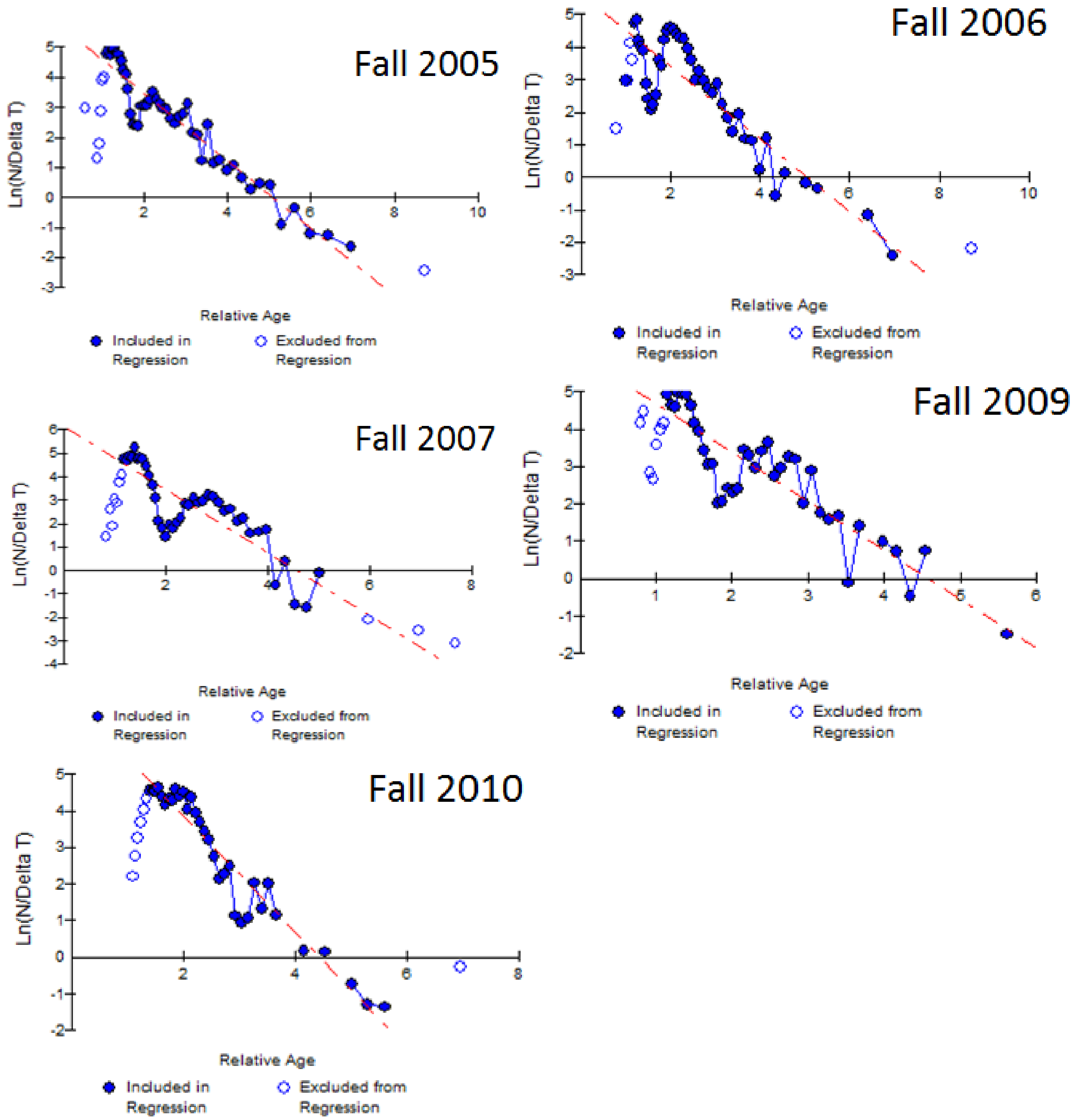


Fig. 6.12.4.1.3.1 Catch curves estimated from 2005 to 2010.

6.12.4.2 Method 2: SURBA

6.12.4.2.1 Justification

The availability of a time series of data from SoleMon surveys allows the use of the SURBA assessment tool. Using the software, the evolution of fishing mortality rates of sole in the GSA 17 was reconstruct starting from the analysis of the length frequency distribution (LFD).

6.12.4.2.2 Input parameters

The main input parameters to run the SURBA-survey based stock analysis are abundances from the SoleMon survey (n. ind/ km^2; Table 6.12.4.2.2.1). The following set of parameters was adopted:

Natural mortality
M vector Age_0=0.7 , Age_1=0.35, Age_2=0.28, Age_3=0.25, Age_4=0.23, Age_{5+}=0.22
Catchability (q)
q(age 0+) = 0.5, q(age 1+) = 1.0, q(age 2+)=1, q(age3+)=1, q(age 4+)=1, q(age 5+)=1
Maturity ogive
Prop. of mature Age_0=0 , Age_1=0.16, Age_2=0.76, Age_3=0.96, Age_4=0.99, Age_{5+}=1
Stock weights at age
Mean weights (kg) Age_0=0.024 , Age_1=0.104, Age_2=0.207, Age_3=0.304, Age_4=0.380, Age_{5+}=0.522

Table 6.12.4.2.2.1Abundances values used in the SURBA model.

N. ind/ km^2	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5+
2005	162.0	86.3	39.3	11.8	3.5	2.2
2006	90.7	174.6	49.4	9.2	2.1	1.2
2007	192.5	146.7	74.9	18.0	1.4	0.6
2008	128.1	114.8	57.6	10.6	5.4	0.1
2009	177.3	83.2	46.6	5.5	1.3	0.2
2010	54.9	200.6	22.7	4.9	0.2	1.4

6.12.4.2.3 Results

The results and the diagnostic of the analyses are summarized in Figures 6.12.4.2.3.1 and 6.12.4.2.3.2 respectively. The results of the model are in general accordance with the previous method providing the same perception of the exploitation of the stock. Moreover a clear decreasing trend in SSB is showed as well as the low recruitment in the last year (cohort effect). Diagnostic plots of SURBA models (Figure 6.12.4.2.3.2) show an adequate fitting of the model in sole data in GSA 17 and absence of trends in the residuals.

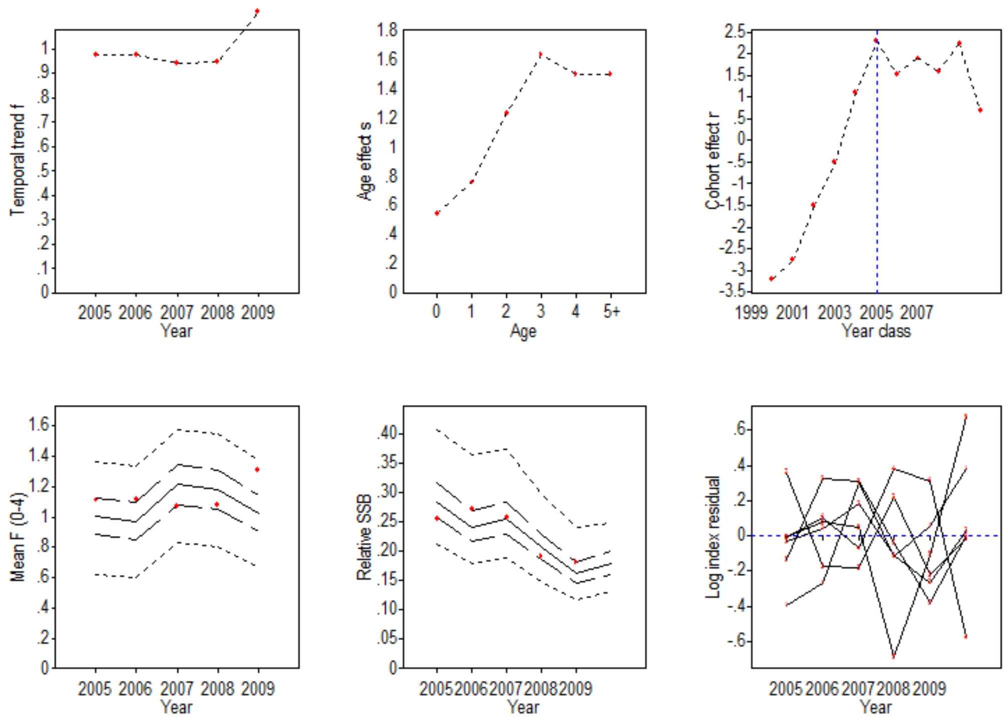


Fig. 6.12.4.2.3.1 Trends in stock parameters (SoleMon survey) in GSA 17 from SURBA.

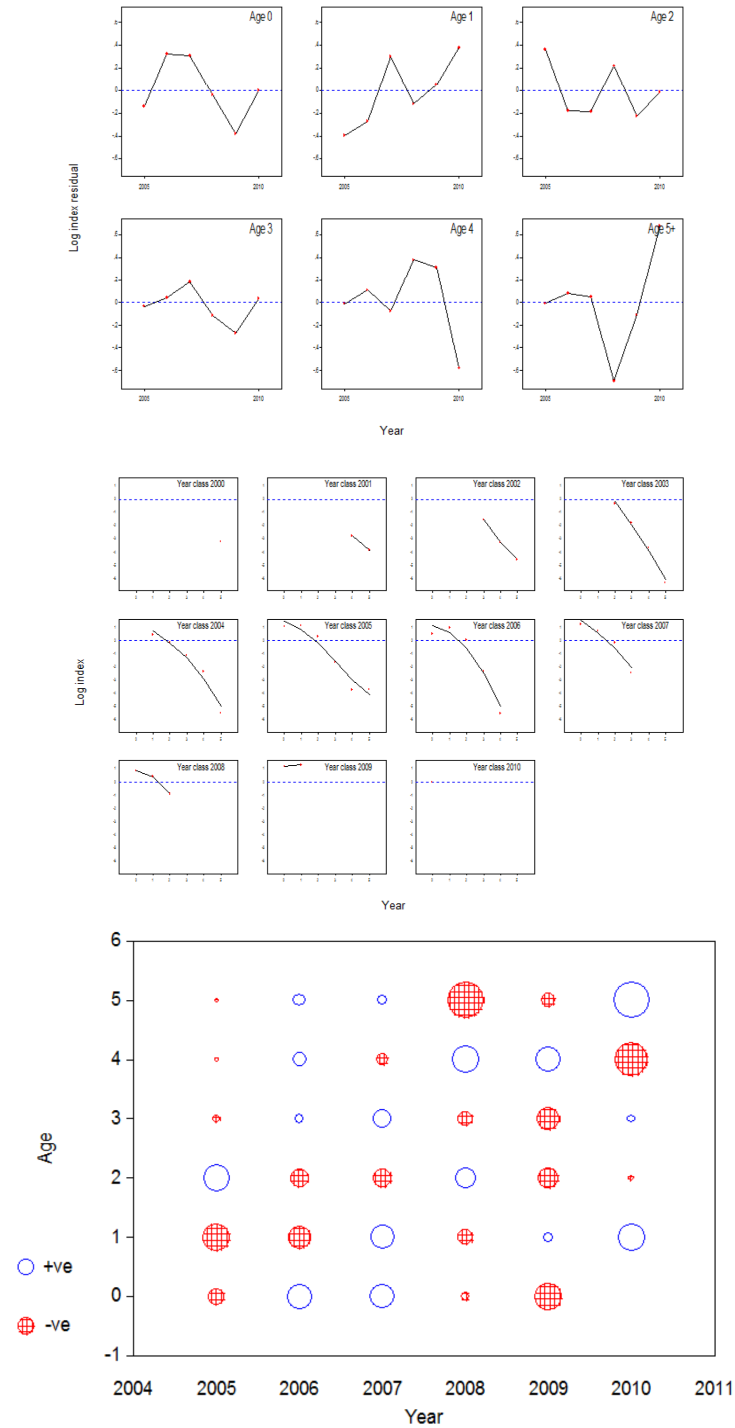


Fig. 6.12.4.2.3.2. Model diagnostic (SoleMon survey) in GSA 17 from SURBA. Residuals trends; comparison between observed (points) and fitted (lines) of survey abundance indices, for each year; bubble plot of log-index residuals by age.

6.12.5 Long term prediction

6.12.5.1 Justification

The same analysis performed in the SGMED-10-02 was used for estimating the biological reference points (BRP).

Availability of biological parameters and length at first capture allows to quantify by simulation the likely changes in Y, B and SSB per recruit in function of fishing mortality (F) with the Yield package.

6.12.5.2 Input parameters

Growth, length-weight relationship, natural mortality and maturity ogive were the same used in the previous paragraphs. Length at first capture was 16 cm TL (about 0.7 year old).

A guess estimate of uncertainty in terms of coefficient of variation (CV=0.2) was added to each parameter.

Beverton and Holt stock-recruit relationship commonly employed for North Sea flatfish (Kell *et al.*, 2005; Pilling *et al.*, 2008) was used with steepness of 0.9 and virgin SSB of 13000 t. The value of steepness represents a hypothesis based on the high resilience of the stocks at low spawning-stock size. The value of virgin SSB was estimated from previous analyses carried out by VIT package. The recruitment variability among years was estimated as CV=0.3 from recruit indices obtained in trawl surveys.

Table X. Input parameters to the yield per recruit analysis.

Natural mortality M vector Age_0=0.7 , Age_1=0.35, Age_2=0.28, Age_3=0.25, Age_4=0.23, Age_{5+}=0.22
Maturity ogive Prop. of mature Age_0=0 , Age_1=0.16, Age_2=0.76, Age_3=0.96, Age_4=0.99, Age_{5+}=1
VBGF: L_{inf} = 36.9; k = 0.44; t_0 = -0.46 Length-weight relationship: a = 0.007; b = 3.0368

6.12.5.3 Results

Estimations of Y and SSB per recruit are shown in Fig 6.12.5.3.1.

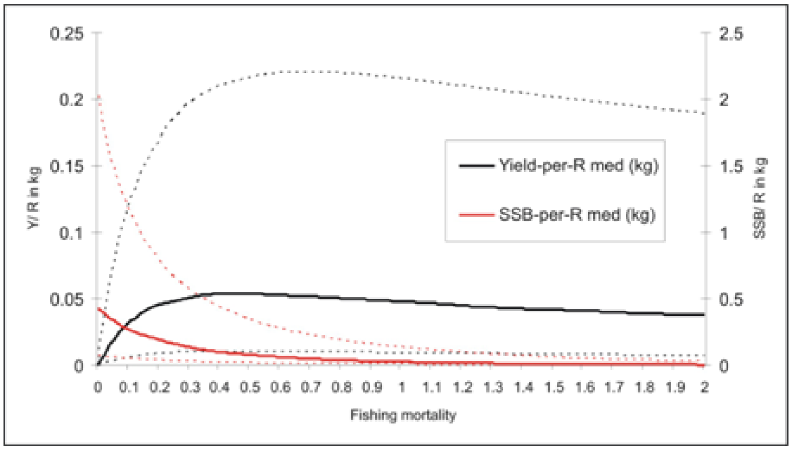


Fig. 6.12.5.3.1 Yield and spawning stock biomass per recruit and corresponding uncertainty of sole in the GSA 17 according to the Yield Package.

Assuming similar selection patterns of both the commercial fisheries and the SoleMon survey (identical gears are used), EWG 11-05 proposed $F_{0.1} \leq 0.26$ as limit reference point consistent with high long term yields (Fmsy proxy). As this value is much lower than the estimated Fref=1.15 (from SURBA), EWG 11-05 classifies the stock as being subject to overfishing.

The effect of several bad recruitment years in a row has been evaluated using the transient analysis of SSB. A fishing mortality rate of 0.24 will result in a probability of 0.05 of the SSB falling below 0.2 of its unexploited level in 20 years.

Tab. 6.12.5.3.1 Yield (kg) per recruit and fishing mortality based BRP of sole for GSA 17 according to the Yield package.

Yield based RP	value	F based RP	value
Y/R_{max}	0.054	F_{max}	0.46
Y/R_{ref}	0.051	F_{ref}	0.32
$Y/R_{0.1}$	0.048	$F_{0.1}$	0.26

6.12.6 Data quality

Common sole DCF data in GSA17 are delivered by Italy and Slovenia, the latter contributes for less than 1% data, quality analyses focused only for the Italian data.

Some doubtfully data were evidenced in the gears contribution of the landings (e.g.: 4% of the landing in 2007 coming from FPO). Differently from the period 2007-2009, in the period 2005-2006 the higher portion of landings was constituted by OTB, such outcome appears unrealistic considering the low efficiency of this gear in exploiting sole. Moreover comparing the amount of landings from different gears with the data available from sampling provided in the framework of previous EWG (SoleMon project, carried out in a portion of the GSA17), appears strange that the TBB constitutes less than 50% of the total landings (Fig. 6.12.6.1).

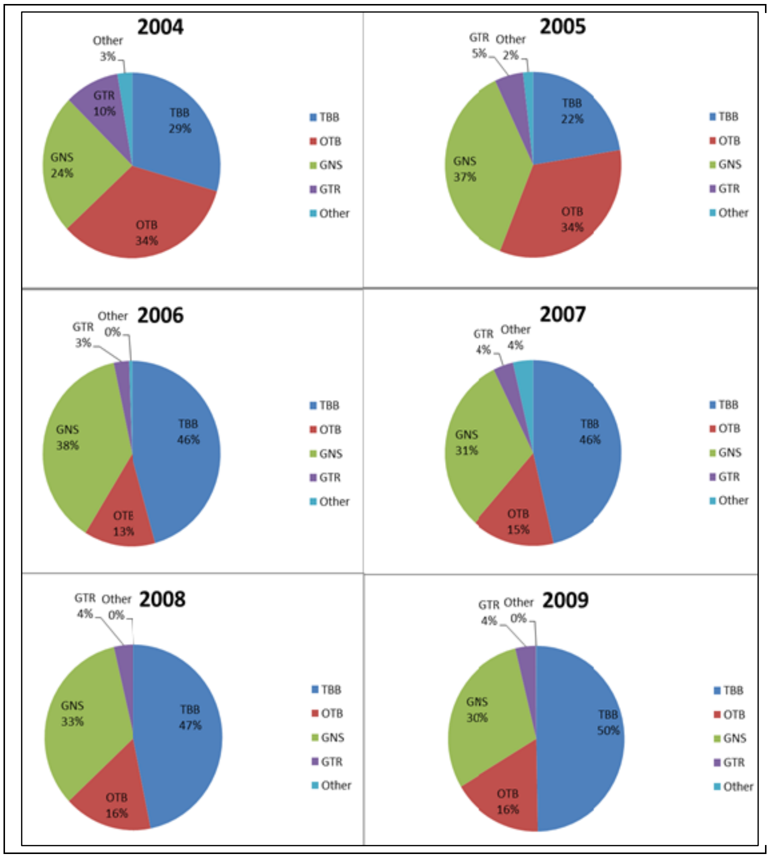


Fig. 6.12.6.1 Landing percentages of the different gears exploiting common sole in GSA17 (DCF data).

Landings at age and at length were available only for beam trawl from 2006 to 2009, data of gillnet were not available in 2007 and 2009, otter trawl data were available only for 2006.

The comparison between "LANDINGS" and "LANDINGS OFAGE" evidenced differences of more than the 10% of the total landings by gear and year. Moreover a difference in the landings at age of 2009 TBB data from the previous year were observed (Fig. 6.12.6.2).

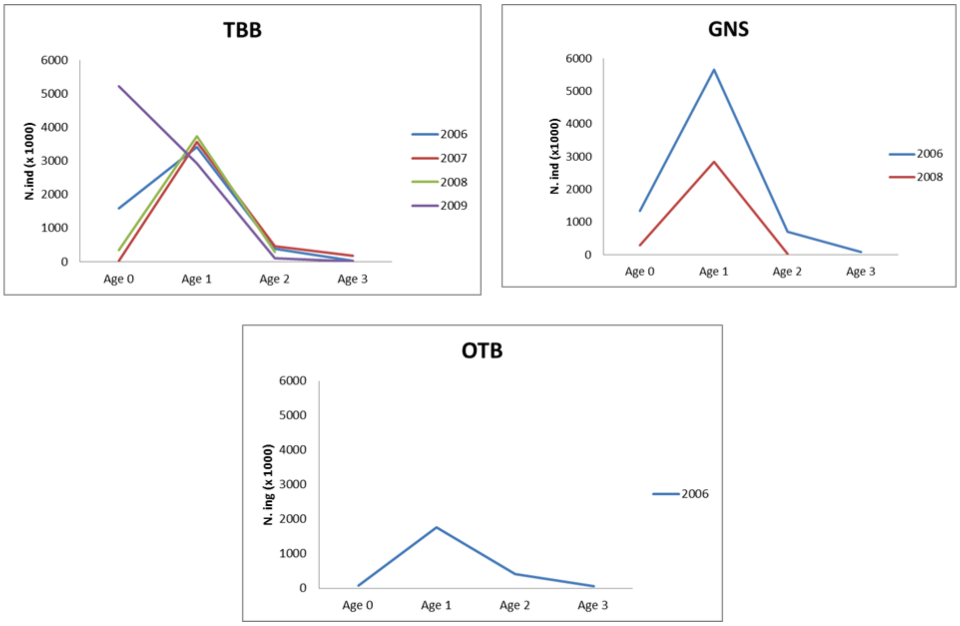


Fig. 6.12.6.2 – Age composition of common sole landings in GSA17 (Italy) for the three main gears (DCF data).

The comparisons between “LANDINGS”, “LANDINGS of LENGTH” and “Sums Of Products” evidenced differences up to 64% of the total landings by gear and year. Moreover significant differences (Kolmogorov-Smirnov test) were observed in the years comparison of the size frequency distributions respectively for GNS and TBB.

Finally the size frequencies distributions from the DCF data are totally inconsistent with the distributions provided in the framework of SoleMon project (Fig. 6.12.6.3), such discrepancies is probably due to inaccuracies in the sampling methodology and strategy.

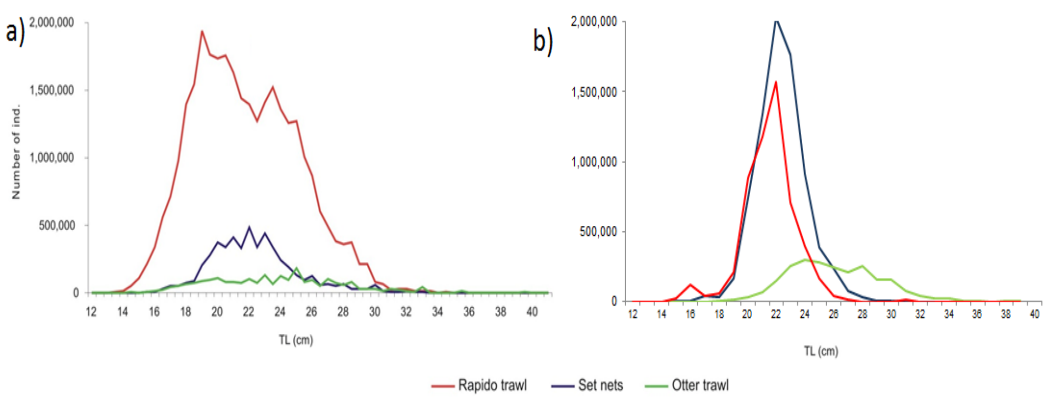


Fig. 6.12.6.3 - Size frequency distributions of landings from SoleMon project (a) and 2006 DCF data (b).

Also, no discards data were available from Italy.

6.12.7 Scientific advice

6.12.7.1 Short term considerations

6.12.7.1.1 State of the stock size

According to the SURBA analyses the SSB decreased from 2007 to 2010. In the absence of proposed and agreed precautionary management reference points EWG 11-05 is unable to fully evaluate the state of the stock size.

6.12.7.1.2 State of recruitment

According to SURBA analyses the recruitment of sole in GSA 17 fluctuated since 2005, reaching the lowest value in 2010.

6.12.7.1.3 State of exploitation

The following statements by EWG 11-05 are conditional of the assumption that the survey based selection patterns is not significantly different from the fisheries' selection patterns.

EWG 11-05 proposes $F_{0.1} \leq 0.26$ as limit management reference point consistent with high long term yields (F_{MSY} proxy).

Based on the SURBA and catch curve analyses, estimates of the fishing mortality in 2010 amount to $F_{0\text{-}4}=1.15$ and F=1.23, respectively, which by far exceed the proposed reference point. EWG 11-05 concludes that the resource is subject to overfishing. EWG 11-05 recommends reductions in fishing effort of the relevant fleets and consistent reductions in landings by means of a multi-annual management plan being agreed and implemented. Such plan needs to account for multi-species effects of such fisheries.

6.12.7.2 Short term considerations

Considering the results obtained by the SURBA model and catch curve analyses, it can be concluded that the resource is over-exploited. A reduction of fishing pressure, especially by *rapido* trawling, is recommended, also taking into account that the exploitation is mainly targeted towards juveniles and the success of recruitment sems to be mostly related to environmental conditions (Domenichetti *et al.*, 2009). Hence, in both cases, namely increasing fishing effort and continued bad recruitment, there could be a high risk of stock depletion. A two–months closure for rapido trawling inside 11 km off-shore along the Italian coast, after the biological fishing ban (August), would be advisable to reduce the portion of juvenile specimens in the catches (sensitive period). For the same reason, specific studies on rapido trawl selectivity are necessary. In fact, it is not sure that the adoption of a larger mesh size would correspond to a decrease of juvenile catches, considering that the mesh opening currently used by the Italian rapido trawlers is larger (48 mm or more) than the legal one. The same uncertainty regards the adoption of a square mesh.

Differently from the previous assessment carried out with XSA using catch at age data, relative SSB values estimated by the SURBA model decreased over the 6 years, probably because in late fall - winter the main spawning area started to be exploited in the last years by Italian set netters and rapido trawlers (Scarella pers. comm). The safeguard of such area might be crucial for the sustainability of the Adriatic sole stock.

Specific studies on rapido trawl selectivity are necessary. In fact, it is not sure that the adoption of a larger mesh size would correspond to a decrease of juvenile catches. The same uncertainty regards the adoption of square mesh.

7 ToR F Quality and completeness of the official Mediterranean DCF data call

7.1 Introduction

The STECF EWG 11-05 undertook a scrutinization of the DCF data sets. Data omissions, inconsistencies and errors were detected by the experts and will be reported to STECF regarding further dissemination to DG Mare and the national DCF correspondents.

The SGMED-10-05 working group recognized that the actual DCF data call as defined and conducted in 2010 to support its analysis in accordance with the ToR from DG MARE significantly improved as compared with previous calls but still had limited success with regard to scientific requirements. Certain data submissions continued to be generally late (after the defined submission date) and erroneous in many instances. SGMED indentified significant inconsistencies between the landings by species declared in the various tables, which appeared further questionable because the submitted age and length compositions hardly covered the declared landings.

In the following section of the present report, comments of data quality review are presented by country and by GSA.

7.2 Review of Spanish data: GSA 01, 05 and 06

Landings data series covers the period from 2002 to 2009. Until 2009 the DCR landings data for Spain were based on log-books data provided by the National Responsible (SGM). Discrepancies were observed when these data were checked with other official sources, such as autonomous governments. Then, a revision of the landings data was made and since 2010 it is the statistics by the autonomous governments of Andalucía, Valencia, Baleares and Catalonia that are taken as data source for landings. There are not data on effort exerted in the three areas.

In general, there is a good agreement between the three measurements of landings (LANDINGS, LANDINGSOFAGE, LANDINGS SOP), mainly in GSAs 05 and 06.

In the database data on ages is only available from OTB and exclusively for some fishes (HKE, MUT) and ARA. Nevertheless, data on ages for other species exist and have been used for assessments by EWG MED.

The SGMED-10-05 highlighted the following remarks for different species on each GSA.

EWG 11-05 noticed that Spain did not provide any fishing effort data.

7.2.1 GSA 01

In this area and for the period 2002-2004 data on ages was missing. In general, the year 2009 must be checked because discrepancies in data (units, raising and discards).

HKE: In 2009 the LANDINGS SOP values are much lower than LANDINGS and LANDINGSOFAGE; being LANDINGSOFAGE smaller than LANDINGS.

Discards data for 2003, 2005 and 2009 was provided, and exceptionally value in 2009 was much higher than that of the other years.

MUR: Landings data for 2009 was provided, without ages data, but as dependant upon their landings volume, which is in line with the DCF requirements.

MUT: In 2008 there is a discrepancy among LANDINGS, LANDINGSOFAGE and LANDINGS SOP, with LANDINGS values being higher than the others. Available ages data is presented for the 2005- 2009 period. Discards data is only provided for the years 2005, 2008 and 2009.

ARA: There are no discrepancies in landings data. Ages data for 2005- 2009 and discards data for 2003, 2005 and 2009 are available.

DPS: Ages data was provided for 2005, 2006, 2007 and 2009, whereas discards data was presented for 2005, 2008 and 2009. In 2009 discards values are very high and this is most likely due to a misuse of the units.

NEP: Data on ages are not provided since landings are inferior to 200 t.

ANE: In 2002, the LANDINGS values (3268 t) are much higher than those of the other years. No data on ages is available.

PIL: Discards data was only presented for 2005, 2006 and 2009 and without data on ages.

7.2.1 GSA 05

HKE: In some years, LANDINGS total is smaller than LANDINGSOFAGE and LANDINGS SOP, while in 2008 LANDINGS values are larger LANDINGSOFAGE and LANDINGS SOP.

NEP and ARA: Only landings data is presented without information on ages because landings values do not exceed 200 t. Although not available in the database, information by ages exits for these species.

DPS: Although landings values are low, data on ages is available.

7.2.2 GSA 06

HKE: Only trawl data is provided. Discards data for 2005 and 2009.

Ages data information was not provided for 2009. Only 2007 Gillnet data was presented and set to 0.

MUR: Only data for 2009 is provided, exclusively for trawl. Discards data for 2009. Ages data is missing.

MUT: Check error in 2007 GTR? Ages data for 2009 was not provided, although it is known that it exist. Discards data is provided for 2005, 2009.

ARA: Ages data are missing in 2009. Discards data is provided for 2009.

DPS: Ages data is missing in 2009. Discards data is only provided for 2005 and 2009.

NEP: Ages data is missing. Discards data is available for 2009 only.

PIL and ANE: Ages data is not provided whereas discards data is only available for 2004.

7.3 Review of Maltese data: GSA 15

The Maltese authorities submitted data in response to both the May 2010 and the November 2010 SGMED data calls. However in both cases data was submitted late:

SGMED data call summer:

Deadline 22nd May 2010

Submitted 28th June 2010

SGMED data call autumn:

Deadline 15th November 2010

Submitted 3rd December 2010

The autumn data was received in time for SGMED 03-2010; however the summer data reached SGMED too late to be used during SGMED 02-2010.

7.3.1 Fisheries landings and discards at age

Malta submitted fisheries landings data for the species requested (*Merluccius merluccius, Mullus barbatus, Spicara smaris, Parapeneus longirostris, Aristeus antennatus, Aristaeomorpha folicea, Nehprops norvegicus, Engraulis encrasicolus* and *Sardina pilchardus*) as well as *Coryphaena hippurus*, one of the species for which member states were invited to submit data.

However data for the following years is missing: MUT *Mullus barbatus*: 2005, ANE *Engraulis engrasicolus*: 2005, 2006, 2007.

No landings / discards at age data were submitted. This is due to the fact that the Maltese authorities are exempt from monitoring age for the requested species according to the exemption rules set out in sub-section B.2.5 of section B (collection of biological variables) in the DCF (2008/949/EC):

The national programme of a Member State may exclude the estimation of the stock related variables for stocks for which TACs and quota have been defined under the following conditions:

(a) The relevant quota must correspond to less than 10 % of the Community share of the TAC or to less than 200 tonnes on average during the previous three years;

(b) The sum of relevant quotas of Member States whose allocation is less than 10 %, must account for less than 25 % of the Community share of the TAC.

Discards data was submitted by Malta only for 2009, and only for the species *Merluccius merluccius, Parapeneus longirostris, Aristaeomorpha folicea, Nephrops norvegicus*. This is due to the fact that under the old DCR Maltese authorities were not obliged to collect discard data. As from 2009 under the new DCF, discards are monitored based on the ranking system referred to in Chapter III section B/B1 3 (1) (b) of the DCF (2008/949/EC). As reported in Malta's annual technical reports made available to SGMED-01-2011, based on the rankings of Maltese landings, the Maltese authorities started to monitor the following DCF Level 4 metiers: drifting longlines (at sea monitoring), lampara nets (at sea monitoring), set longlines (market sampling), purse seines (on board observations during harvesting) and bottom otter trawls (at sea monitoring).

A notable omission to the discards data is for *Mullus barbatus* and *Mullus surmuletus*, which are targeted by bottom otter trawls but for which no discards data was provided.

7.3.2 Fisheries landings at length data

Length structures of total landings were submitted for 2006-2009 for *Coryphaena hippurus*, one of the species for which member states were invited to submit data, and for 2009 for *Merluccius merluccius, Parapeneus longirostris, Aristaeomorpha folicea, Nephrops norvegicus*, *Mullus surmuletus* and *Mullus barbatus*. This is in line with the new DCF requirements and what is reported in Malta's annual technical reports made available to SGMED-01-2011: the Maltese authorities started to monitor stock related variables in line with the ranking system detailed in 2008/949/EC in 2009.

A notable error was however the omission of mean weight per length class information in the uploaded data.

7.3.3 Fisheries discards at length data

Discards data was submitted by Malta only for 2009, and only for the species *Merluccius merluccius, Parapeneus longirostris, Aristaeomorpha folicea, Nephrops norvegicus*. This is due to the fact that under the old DCR Maltese authorities were not obliged to collect discard data. As from 2009 under the new DCF, discards are monitored based on the ranking system referred to in Chapter III section B/B1 3 (1) (b) of the DCF (2008/949/EC).

A notable error was the omission of mean weight per length class information in the uploaded data. As was the case for total discards data, discards at length data was missing for *Mullus barbatus* and *Mullus surmuletus*.

7.3.4 Fisheries effort data

Fisheries effort data in terms of Days, KW*Days, GT*Days was submitted for GSA 15 disaggregated at DCF fleet level 4 as requested in the data call. However the quality of the data provided was not satisfactory, with large and in some cases implausible annual variations in fishing effort for the same gear.

7.3.5 Survey data

MEDITS data (TA, TB and TC files) were made available to the group as requested in the 2010 data call. However implausible data was found in the submitted MEDITS files and overall the quality of the MEDITS data submitted in 2010 was not deemed satisfactory by the group.

No MEDIAS data was submitted for GSA 15 by the Maltese authorities.

7.4 Review of Italian data: GSA 09, 10, 11, 16, 17, 18, 19

SGMED 10-03 reported that fisheries data for 2009 were not reported in due time (before the deadline in the DCF 2010 MED data call) and only made avalie in advance of the experts meeting. 2010 MEDITS data were not submitted in 2010.

Due to time constraints and lack of expertise EWG 11-05 did evaluate the DCF data quality only in GSA 17 and commented accordingly.

7.4.1 GSA 17

Some doubtfully data were evidenced in the gears contribution of the landings (e.g.: 4% of the landing in 2007 coming from FPO). Differently from the period 2007-2009, in the period 2005-2006 the higher portion of landings was constituted by OTB, such outcome appears unrealistic considering the low efficiency of this gear in exploiting sole. Moreover comparing the amount of landings from different gears with the data available from sampling provided in the framework of previous EWG (SoleMon project, carried out in a portion of the GSA17), appears strange that the TBB constitutes less than 50% of the total landings (Fig. 7.4.1.1).

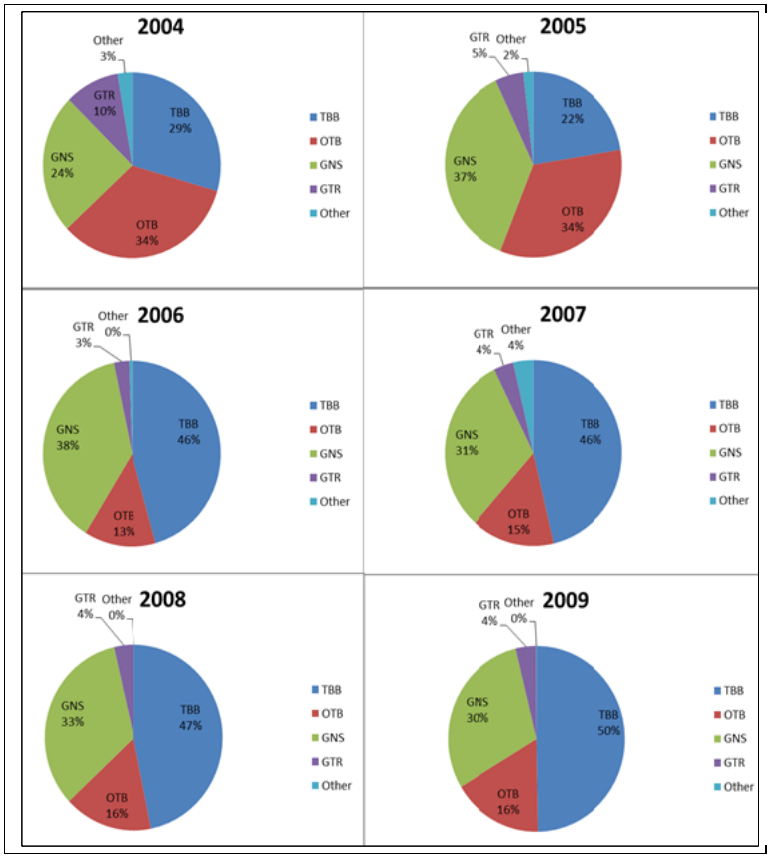


Fig. 7.4.1.1 Landing percentages of the different gears exploiting common sole in GSA17 (DCF data).

Landings at age and at length were available only for beam trawl from 2006 to 2009, data of gillnet were not available in 2007 and 2009, otter trawl data were available only for 2006.

The comparison between “LANDINGS” and “LANDINGS OFAGE” evidenced differences of more than the 10% of the total landings by gear and year. Moreover a difference in the landings at age of 2009 TBB data from the previous year were observed (Fig. 7.4.1.2).

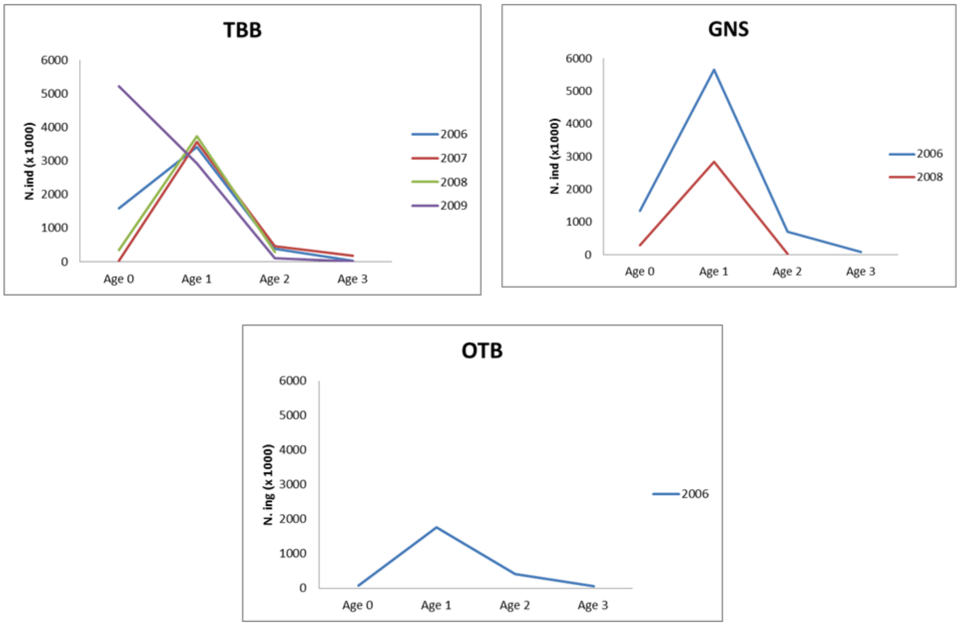


Fig. 7.4.1.2 – Age composition of common sole landings in GSA17 (Italy) for the three main gears (DCF data).

The comparisons between “LANDINGS”, “LANDINGS of LENGTH” and “Sums Of Products” evidenced differences up to 64% of the total landings by gear and year. Moreover significant differences (Kolmogorov-Smirnov test) were observed in the years comparison of the size frequency distributions respectively for GNS and TBB.

Finally the size frequencies distributions from the DCF data are totally inconsistent with the distributions provided in the framework of SoleMon project (Fig. 7.4.1.3), such discrepancies is probably due to inaccuracies in the sampling methodology and strategy.

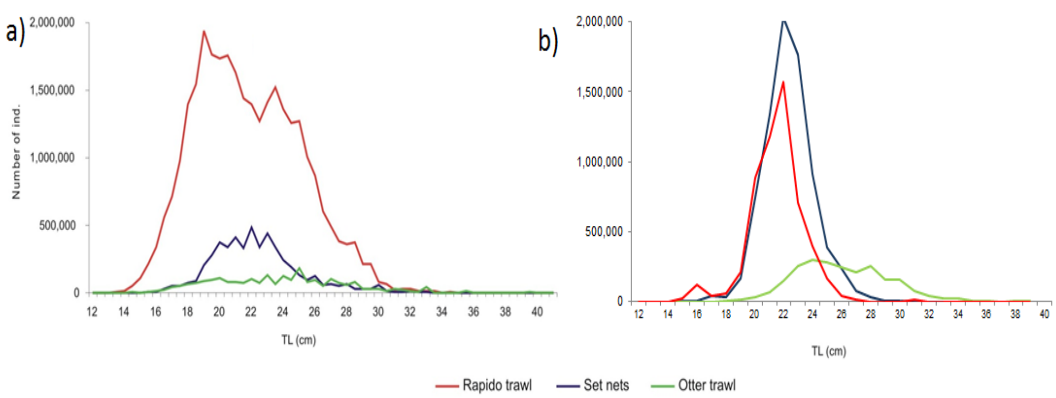


Figure Fig. 7.4.1.3 - Size frequency distributions of landings from SoleMon project (a) and 2006 DCF data (b).

Also, no discards data were available from Italy.

7.5 DCF data review of coastal species

EWG 1105 noticed that the Marine Strategy Framework Directive emphasizes the necessity of considering the coastal waters as an integral part of the marine environment, and as such the environmental status of coastal waters and the anthropogenic factors impinging on them should be evaluated and monitored. Furthermore, the European Parliament (EP), through the Green Paper of the Reform of the Common Fisheries Policy (CFP) and the Resolution of 13 January 2009 on the CFP and the ecosystem approach to fisheries management (2008/2178), reiterates the need to study and adopt measures in relation to a multitude of factors that have a profound impact on the sustainability of marine coastal ecosystems and draws attention to the key importance of the fisheries sector in some coastal communities of the EU. The EP also emphasises the necessity to recognise the specific character and importance of small-scale inshore fishing and artisanal fishing.

The small-scale fleet is significant in Europe and represents a large majority of the total number of vessels for all the Member States except Netherlands and Belgium (Ifremer, 2007). Small scale fisheries are strongly represented in all EU Member States (81% and 87% of the EU 25 whole fleet is composed of vessels less than 12 and 15 meters respectively) and approximately 100,000 crew are involved in these type of fisheries in Europe (Ifremer, 2007). Mediterranean small-scale fisheries are characterized as commercial fishers operating in small boats (less than 12 m length) exploiting areas located near the coast using a large number of gears and techniques (which change seasonally), which predominantly are passive gears, and targeting a high diversity of species (see e.g. Coppola, 2003; Ifremer 2007). Even though there is not an official (governmental) definition of artisanal fisheries, the characteristics given before can be considered here as a preliminary description of what Mediterranean small scale fisheries are[1]. These characteristics complicate assessment, monitoring and management of the sector. Indeed, most Mediterranean countries usually lack or have a shortage of scientific biological data on the coastal exploited species and long-term monitoring data of small scale fish catches. Therefore, coastal species have been poorly monitored and evaluated in the Mediterranean. In fact, fisheries science and management still tend to ignore small-scale fisheries and coastal resources worldwide (Berkes et al. 2001; Pauly, 2006; Pauly, 2006). Artisanal fisheries are also responsible in certain areas of a non-negligible fraction of the spawning part of the population of certain demersal, non-coastal species (e.g. *Merlucius merluccius*).

In this sense, the stock assessments carried out at the different SGMED meetings (see e.g. SGMED 10-03 report for an overview) have been a first step towards the ecosystem approach to fisheries management in the Mediterranean because these assessments included different species inhabiting different habitats (pelagic, demersal, coastal, deep waters). SGMED agreed (see SGMED 10-03 report) to follow up with fisheries specific analyses accounting for multispecies and ecologic effects. The evaluation of coastal species in the Mediterranean is a key action to undertake in the future by SGMED. Here, the analysis is done considering the following coastal species included in the official Mediterranean DCF data call issued on 29 April 2010[2]: *Boops boops, Dicentrarchus labrax, Pagellus erythrinus,* Mugilidae*, Pagellus acarne, Sparus aurata* and *Diplodus* spp.

This analysis determines the quality problems associated with landings and MEDITS data on coastal species provided during the meeting STECF-EWG II-05 meeting. These problems may underpin the elaboration of stock assessment for these species. The analysis is complemented by the case study presented during the meeting entitled "A case study showing the data shortcomings to assess Mediterranean coastal species" (background documents listed in the present report).

For the purposes of this review, coastal waters are defined as those waters at depths shallower than 50 meters.

[1] A definition will be agreed during the European Science Foundation (ESF) exploratory workshop on coastal fisheries that will be held in September at the University of Algarve Portugal (http://www.esf.org/activities/exploratory-workshops/workshops-list/workshops-detail.html?ew=10784)

[2] Tables 1 and 2 of the DCF data call

7.5.1 Landings

Table 7.5.1.1 shows the landings information available to SGMED group for coastal species during the meeting STECF-EWG II-05 [3]. These are the main data problems:

1. Countries: Only four countries reported data on few coastal species requested; see in Table 7.5.1.1: Cyprus (GSA 24, 26), France (GSA 7), Italy (GSAs 9, 10, 11, 16, 17, 18, 19), Slovenia (GSA 17). Italy is the country reporting data in a more disaggregated way. Slovenia reports data for one year only (2009)

2. Gears:

a. Some countries (e.g. France) only reports data for otter trawl (gillnet data is only reported in one year). Since a largest part of landings of these species are expected to be made by artisanal fishing gears (see Figure 7.5.1.1 for Italy according to DCF data, and Fig. 7.5.1.2 for France according to Ifremer, 2002), the absence of landings data from artisanal fishing gears poses a major problem for the assessment.

b. For those countries reporting landings from artisanal fishing, some ladings attributed to certain gears are doubtful. Thus for example, a large quantity of *Boops boops* landings in Italian waters are attributed to pots and traps, driftnets and drifting longlines, which seems quite impossible. Similar to this, large quantities up *Dicentrarchus labrax* landings in Italy are attributed to pots and traps and to driftnets (also doubtful). Finally, in some cases the gear is not defined (the value -1 is given).

3. GSAs: Some GSAs given by country are doubtful, e.g. GSA 14 for Cyprus.

4. Landings at age: data are only provided for *B. boops* and *S. aurata* in GSA9 by Italy in 2009 and for *S. aurata* in GSA 7 by France in 2006-2009. However, the times difference between total landings and landings at age ranges from 1.5 to 8.3 times, indicating large errors in the landings data reported.

5. Landings at length: data are only provided for *B. boops* in GSA9 in 2009 by Italy, for *D. labrax* and *S. aurata* in GSA7 by France (2002-2009) and for *P. erythrinus* in GSA 9,16,18,19 in 2009 (not all gears are given). However, the difference between total landings and landings at length ranges from 1.4 to 700 times, indicating large errors in the landings data reported.

6. Other considerations: there is no data on recreational fishing. Recreational fishing is an increasing leisure activity in coastal zones worldwide, involving large numbers of people and consequently high levels of fishing effort (see e.g. Cowx, 2002, Cooke and Cowx, 2004). Several recent studies have revealed that commercial and recreational fishing can have similar ecological consequences on fished populations and that in different coastal areas around the world, including the Mediterranean, an increasing proportion of coastal species catches is made by recreational fishers (see e.g. Cowx, 2002, Cooke and Cowx 2004; Lloret et al. 2008). In Europe, however, marine recreational fisheries are poorly monitored. Thus for example, under the Commission Decision of 6 November 2008 (2008/949/EC)[4] countries are expected to provide only tuna and eel recreational data in the Mediterranean region. Therefore, the Decision does not include the collection of recreational fishing data for coastal species. Without the collection of data from these coastal species captured by recreational fishers, as it is being done in other parts of the world, e.g. US (see e.g. National Research Council, 1999, 2006) and Australia (see e.g. Summer and Williamson 1999), the assessment of coastal species will be impaired.

[3] Coastal species from tables 1 and 2 of the official Mediterranean DCF data call issued on 29 April 2010

[4] EC decision adopting a multiannual Community programme pursuant to Council Regulation (EC) No 199/2008 establishing a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy

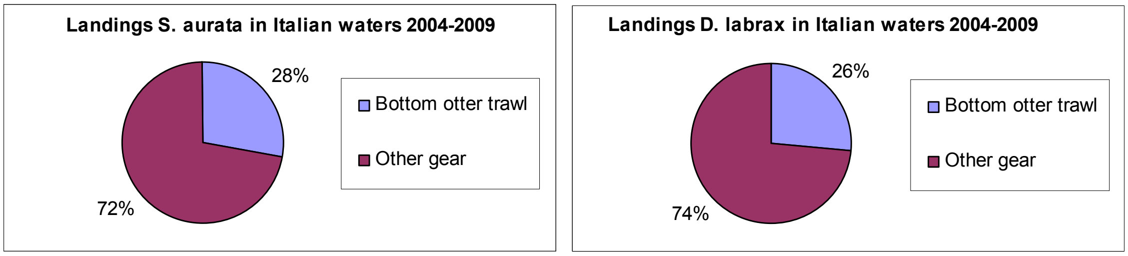


Fig. 7.5.1.1. Landings of *D. labrax* and *S. aurata* in Italian waters by metier.

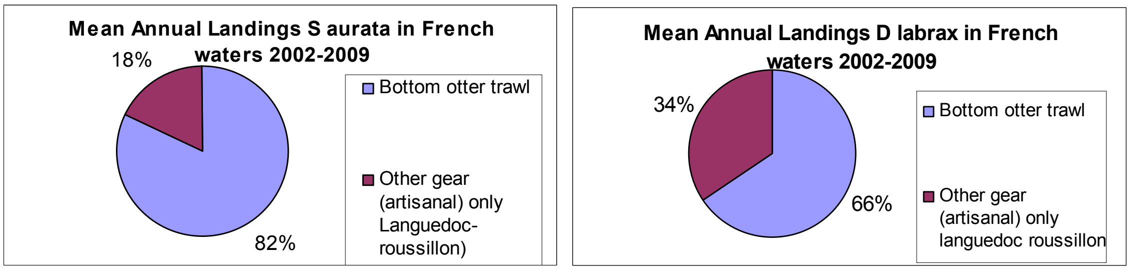


Fig. 7.5.1.2. Mean annual landings (2002-2009) of *D. labrax* and *S. aurata* disaggregated by metier in French waters. The bottom otter trawl data is provided by the DCF from the whole GSA7 whereas the artisanal fishing data are from a portion of the GSA7 (Languedoc-Roussillon region; Ifremer 2002).

Table 7.5.1.1. Landings information available to SGMED group for coastal species[5] during the meeting STECF-EWG II-05. Diff L-La is the average times difference between landings and landings at age data, Diff LA-LSOP is the average times difference between landings at age and landings SOP data, Diff L-LL is the average times difference between landings and landings at length data (1 indicates a perfect fit), Diff LL-LSOP is the average times difference between landings at length and landings SOP data. FPO: Pots and traps, GND: driftnet, LLD: drifting longlines, PS purse seining, OTB: bottom otter trawl, OTM: midwater otter trawl, GNS: gillnet, GTR: trammel net

SPECIES	COUNTRY	YEARS	GEARS	Inconsistent gears	Landings at age	Landings at length	Diff L-LA	Diff LA-LSOP	Diff L-LL	Diff LL-LSOP
Boops boops	Cyprus	2009	All							
	France	2002-2009	OTB, OTM, 1 year GNS							
	Italy	2004-2009	All	FPO (up to 62t), GND (up to 60t), LLD	GSA9 in 2009	GSA9 in 2009 but only few gears	4.5	0.99	3.02	1
	Slovenia	2005-2009	All							
Dicentrarchus labrax	Cyprus	2009	GTR							
	France	2002-2009	OTB			GSA7 in 2006-2009			2.7	
	Italy	2004-2009	All	GND(1t), FP0 (<1t)						
	Slovenia	2005-2009	All							
Mugilidae	Cyprus	2009	GTR							
	France									
	Italy	2004-2009	all							
	Slovenia	2005-2009	All							
Pagellus erythrinus	Cyprus	2009	OTB, GTR							
	France	2002-2008	OTB, OTM, 1 year GNS							
	Italy	2004-2009	All			GSA9,16,18,19 in 2009 but not all gears			711	0.63
	Slovenia	2005-2009	all							
Sparus aurata	Cyprus	2009	GTR							
	France	2002-2009	OTB, OTM, 1 year GNS		GSA7 in 2006-2009	GSA7 in 2002-2009	1.53	1	1.39	1.38
	Italy	2004-2009	All	FPO(<1t)	GSA9 in 2009		8.26	1		
	Slovenia	2005-2009	All	FPO(<1t)						
Diplodus spp	Cyprus	2009	LLS							
	France									
	Italy	2004-2009	All							
	Slovenia									
Pagellus acarne	Cyprus	2009	OTB, GTR							
	France									
	Italy									
	Slovenia									

[5] Coastal species from tables 1 and 2 of the official Mediterranean DCF data call issued on 29 April 2010.

7.5.2 MEDITS data

As shown in table 7.5.2.1, some coastal species are not well represented in the catches of MEDITS. Thus for example, Mugilidae, *D. sargus, D. labrax* and *S. aurata* only appear in relatively few hauls and in small numbers. Therefore, MEDITS trawl survey is not efficient for evaluating these coastal species that are mainly restricted in shallow waters (see background documents). Only *B. boops, P. erythrinus* and *P. acarne* appear in relatively large number of hauls, in large numbers. However, even in those cases, the efficiency of MEDITS to sample these species is doubtful. Thus, the evaluation of *P. erythrinus* and *P. acarne* MEDITS ES data carried out in the frame of the "Atlas of the Spanish Fishery Species" (IEO, in press), showed that both stocks are distributed in coastal waters mainly (<60 m depth) and therefore the capacity of MEDITS ES to sample these species is rather limited (see the example for *P. erythrinus* in Fig. 7.5.2.1 and 7.5.2.2). The analysis of *P. acarne* and *P. erythrinus* based on MEDITS data done by Spedicato et al (2002) also showed that in many sectors of the Mediterranean shelf covered by the MEDITS, the highest abundance and biomass indices of both species are found in the shallowest strata (0-50 m depth, Fig. 7.5.2.1).

Furthermore, nearly all individuals caught by MEDITS were juveniles or small adults (see the example for *P. erythrinus* in Fig. 7.5.2.2). The study carried out by Spedicato et al (2002) also showed that *P. acarne* and *P. erythrinus* catches obtained along the Mediterranean shelf with the MEDITS trawl survey are made of juveniles and small adults (10-20 cm in length). These results suggest that most adults of these sparids remain inaccessible to MEDITS trawl survey, because they live in rocky habitats inaccessible to trawl where they are targeted by artisanal fishing using gears such as gillnet and longline. Furthermore, considering that these species are hermaphrodite, the skewed sampling of MEDITS towards small individuals means that obtained sex ration is biased. Overall, it is here suggested that in cases such as *P. acarne* and *P. erythrinus*, MEDITS data can only be used as a recruitment index.

Tables 7.5.2.2 and 3 show the number and percentage of trawls carried out by MEDITS surveys in coastal waters (<50 m depth) in the different GSAs (1994-2010). Only a small percentage (<15%) of trawls have been done at depths < 50 m (all years, all GSAs). Nevertheless, there are differences between and within sectors / years: in GSAs 2, 5, 8 and 15 the percentage falls below 2%, whereas in GSA 17 about 70% of the total hauls were carried out at <50m. It is here concluded therefore that the MEDITS survey cannot sample effectively the coastal waters. This is logical because these waters comprise complex areas such as rocky bottoms, coralligenous beds and *Posidonia oceanica* meadows that are not possible to sample with trawl.

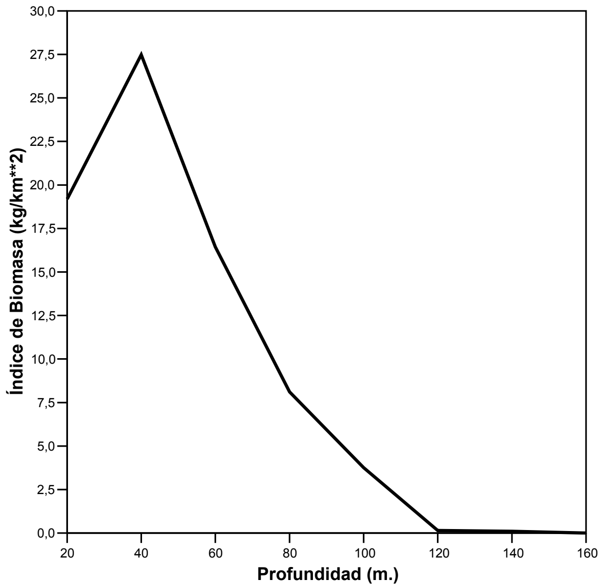


Fig. 7.5.2.1. MEDITS ES (Spain) biomass indices for *P. erythrinus* according to depth (source: Lloret & Ferrandis, In: IEO Atlas of the Spanish Fishery Species, in press)

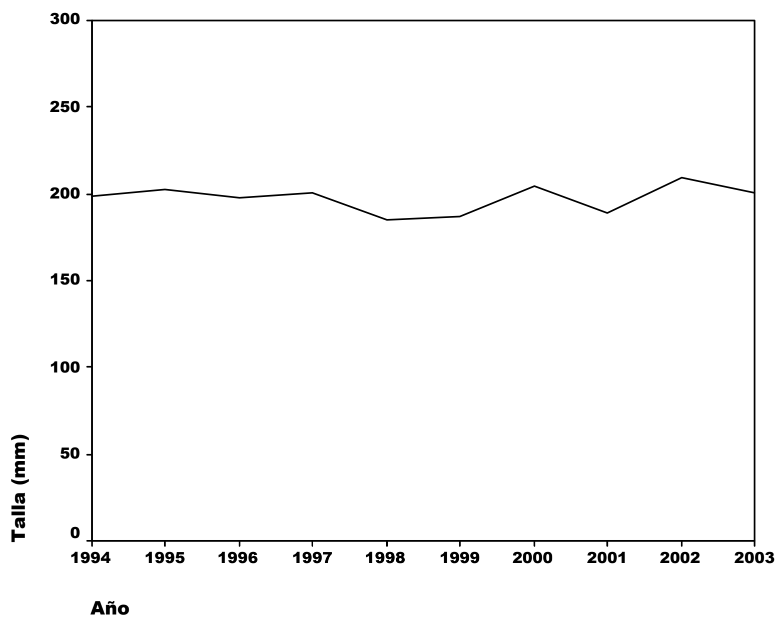


Fig. 7.5.2.2. MEDITS ES (Spain) mean annual length for *P. erythrinus* (source: Lloret & Ferrandis; In: IEO Atlas of the Spanish Fishery Species, in press)

Table 7.5.2.1. Coastal species[6] appearing in the MEDITS surveys (all countries and years together; see table 7.5.1.1). The number of trawl hauls in which the species appears and the total number of individuals caught by species is indicated

Species	Nr hauls appearing	Nr individuals
B boops	5000	185000
Mugilidae	139	1830
D. labrax	63	116
S. aurata	98	546
P. acarne	2717	180000
P. erythrinus	4000	63000
D. sargus	33	168

Table 7.5.2.2. Number of trawl hauls carried out in shallow waters (stratum 10-50m depth) during MEDITS surveys (1994-2010) in different GSAs

GSA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	SUM
1	23	26	33	32	31	37	34	34	41	44	41	37	40	36	34	31	25	579
2	0						0						0	0	0	0		0
5	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
6	53	71	69	67	59	76	74	83	91	97	84	84	92	103	112	109	87	1411
7	68	66	62	68	69	62	65	64	60	71	66	63	65	65	51	60	56	1081
8	25	26	27	17	28	26	25	25	1	25	26	27	27	21	28	24	21	399
9	136	136	136	136	134	136	136	136	105	104	102	103	103	105	102	103	1	1914
10	98	99	99	99	100	98	99	99	84	85	84	84	84	84	84	84		1464
11	117	107	123	125	122	123	121	122	99	99	95	96	97	100	95	97		1738
15									2	45	43	45	44	45	44	46	45	359
16	37	41	41	41	42	42	42	42	67	67	76	120	115	120	120	120		1133
17			2	2	2	2	2	2	173	118	113	175	115	115	118	115		1054
18	72	72	72	72	72	72	72	72	97	94	97	67	67	65	59	65		1187
19	73	74	74	74	74	74	74	74	77	77	70	70	70	70	71	71		1167
20	11	14	22	18	32	31	31	31		32	31	31	30		32			346
22+23	92	103	133	145	146	143	141	138		142	147	148	147		148			1773
25												25	25	25	27	27	27	156
																		15761

Table 7.5.2.3. Percentage of trawl hauls carried out in shallow waters (stratum 10-50m depth) during MEDITS surveys (1994-2010) in different GSAs

GSA	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Mean
1	8.7	3.8	6.1	6.3	6.5	5.4	5.9	8.8	7.3	6.8	7.3	5.4	7.5	8.3	11.8	6.5	12.0	7.3
2	0.0						0.0						0.0	0.0	0.0	0.0		0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	13.2	11.3	10.1	10.4	11.9	10.5	12.2	9.6	12.1	9.3	10.7	13.1	12.0	5.8	6.3	5.5	5.7	10.0
7	17.6	18.2	19.4	20.6	17.4	19.4	18.5	18.8	20.0	18.3	18.2	19.0	18.5	21.5	21.6	18.3	21.4	19.2
8	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
9	14.0	13.2	13.2	13.2	14.2	13.2	13.2	13.2	12.4	12.5	12.7	13.6	12.6	12.4	12.7	13.6	0.0	12.4
10	9.2	10.1	10.1	10.1	10.0	10.2	10.1	10.1	10.7	10.6	10.7	10.7	10.7	10.7	10.7	10.7		10.3
11	13.7	16.8	17.1	16.8	17.2	16.3	15.7	13.9	20.2	18.2	17.9	17.7	19.6	19.0	17.9	18.6		17.3
15									0.0	2.2	4.7	2.2	2.3	0.0	0.0	0.0	0.0	1.3
16	10.8	9.8	9.8	9.8	9.5	9.5	9.5	9.5	10.4	10.4	9.2	8.3	8.7	9.2	9.2	9.2		9.6
17			100.0	100.0	100.0	100.0	100.0	100.0	34.1	39.8	43.4	36.0	44.3	47.0	44.9	44.3		66.7
18	19.4	20.8	20.8	19.4	19.4	19.4	19.4	20.8	13.4	13.8	12.4	13.4	14.9	16.9	16.9	15.4		17.3
19	12.3	12.2	12.2	12.2	12.2	12.2	12.2	12.2	11.7	11.7	12.9	12.9	12.9	11.4	12.7	12.7		12.3
20	18.2	14.3	9.1	11.1	12.5	9.7	9.7	9.7		9.4	9.7	9.7	10.0		9.4			10.9
22+23	10.9	9.7	8.3	6.9	8.9	8.4	9.2	9.4		9.2	8.8	9.5	9.5		8.8			9.0
25												20.0	20.0	20.0	18.5	18.5	18.5	19.3
																		13.1

[6] Coastal species from tables 1 and 2 of the official Mediterranean DCF data call issued on 29 April 2010.

7.5.3 Recommendations

STECF EWG 11-05 recommends that a specific sampling plan to survey coastal species should be implemented which considers both artisanal as well as recreational fisheries. For that, it would be necessary to establish an EU working group specialised in coastal fisheries to design a specific sampling protocol in coastal waters. This plan should consider both commercial and recreational fishing sectors and the possible implementation of a specific fishery independent scientific survey (e.g. trammel net survey and visual census) in particular areas along the coast.

STECF EWG 11-05 recommends that the future revision of the DCF data call considers the collection of data of some few coastal species that are good indicators of the status of particular coastal areas. These should include species that are vulnerable to both fishing and other impacts (habitat destruction or modification, climate change, etc) because of their life history traits (slow growth, complex reproductive strategy, etc).

7.6 DCF data review of small pelagic species (GSA17)

7.6.1 Landings at age data sheet

Data available from Italy only (2004-2009); data from Slovenia are missing for the entire 2004-2009 period.

Landings of ITA (ANE & PIL) are reported for different fisheries, including: DEMSP (Demersal species), MDDWSP (Mixed demersal and deep water species), SLPF (Small and large pelagic fish), LPF (Large pelagic fish) and SPF (Small pelagic fish). The EWG expressed its opinion that figures of ANE and PIL entered for LPF fishery are probably biased (considering mesh size of PS gear to capture large pelagic fish)!

Landings of ITA (ANE & PIL) are reported for different gears, including: FPO (Pots and Traps), FYK (Fyke nets), GNS (Set gillnet), OTB (Bottom otter trawl), PS (Purse seine), PTM (Midwater pair trawl) and TBB (Beam trawl). In EWG opinion, landing figures of ANE and PIL entered for some gears (i.e. FPO, FYK) are strange and should be checked (Table 7.6.1.1).

Table 7.6.1.1. Landing at age data sheet

		GEAR	2004	2005	2006	2007	2008	2009
PIL	ITA	GNS (SLPF)			7,0228			
PIL	ITA	PS (LPF)		18,8036				
ANE	ITA	GNS	0,0673					
ANE	ITA	PS (LPF)		**121,8026**				
ANE	ITA	FPO	0,0245			0,5382		
ANE	ITA	FYK	0,0908	0,1978			1,2449	1,0713

Data by age classes for PS (ITA) are missing in the years 2004-2008, as well as data for PTM (ITA) in the years 2004-2005.

Differences between landing and landing at age have been noticed (Fig. 7.6.1.1). The highest difference between landing and landing at age for PIL (ITA) has been noticed in 2009 (gear: PTM). In the case of ANE, differences between landing and landing at age for the years 2006-2008 are positive for PTM and negative for PS, approximately equal and compensate each other (Table 7.6.1.2). However, large difference in 2009 for ANE caught by PTM has been noticed.

Table 7.6.1.2. Differences between landing and landing at age for ANE (ITA).

Year	GEAR	Landing	Landing at age	Difference
2006	PS	8338,337	12993,66115	-4655,32445
2006	PTM	34896,65	30323,45099	4573,20361
2007	PS	5625,728	8752,29722	-3126,56922
2007	PTM	32604,36	29477,79072	3126,56928
2008	PS	3280,465	5727,577689	-2447,11299
2008	PTM	22799,72	20352,17574	2447,54786
2009	PS	4062,352	4269,786921	-207,434621
2009	PTM	26826,09	7262,807773	19563,2798

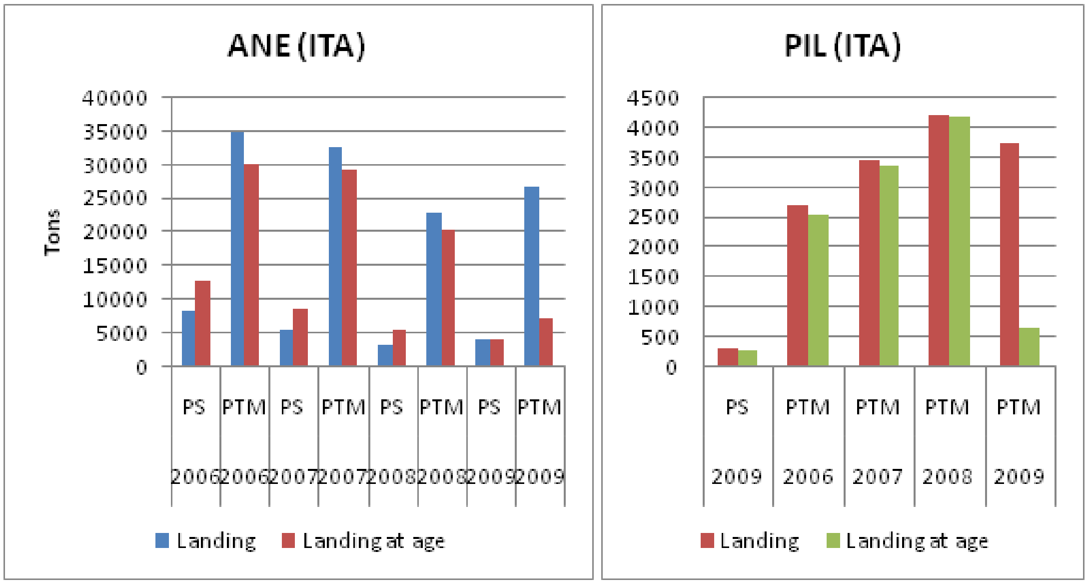


Fig. 7.6.1.1 Differences between landing and landing at age data.

Age and length data on discards are not available. Data on discard quantity for ANE and PIL are available from SVN only (2005-2009). Discard data from ITA are missing.

7.6.2 Landings at length data sheet

Landings of (ANE & PIL) from SVN are reported for different gears, including: GND (Driftnets), LLS (Set longlines)and OTM (Midwater otter trawl). In EWG opinion, landing figures of ANE and PIL for these gears should be checked (Table 7.6.2.1).

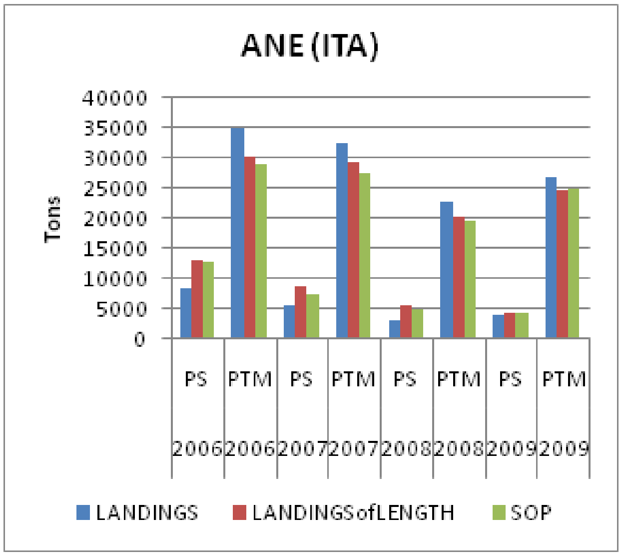
Table 7.6.2.1. Some of the landings of ANE and PIL as reported by SVN.

		GEAR	2005	2006	2007	2008	2009
PIL	SVN	GND	8,274	1,446	2,31	1,456	0,568
PIL	SVN	LLS	0,75	0,14			
PIL	SVN	OTM					2,191
ANE	SVN	GND			0,001		
ANE	SVN	OTM				0,014	1,374

From Italian NP Proposal 2009-2010 (page 21): Beach and boat seine [SB] [SV] in the Appendix IV of the Commission Decision (2008/949/EC) consider as target assemblage only demersal species. In Italy this kind of gear targets also small pelagic fish. For this reason, in order to cover all the metiers operating in the national waters, Beach and boat seine targeting small pelagic fish have been added to the matrix (see Table III.C.1).

Landings data for PIL (ITA) concerning landings of beach and/or boat seine (SB – SV) targeting small pelagic fish assemblages (sardine fry fishery) as well as corresponding effort data for these gears are missing for recent years (see Italian NP). It seems that no data are available from fry fishery targeting small pelagic.

Landings at length data for PIL and ANE: large differences between figures of Landing and Sum of Products (SOP) in the years 2006-2008 have been noticed in data from SVN (Fig. 7.6.2.1 and 7.6.2.2).



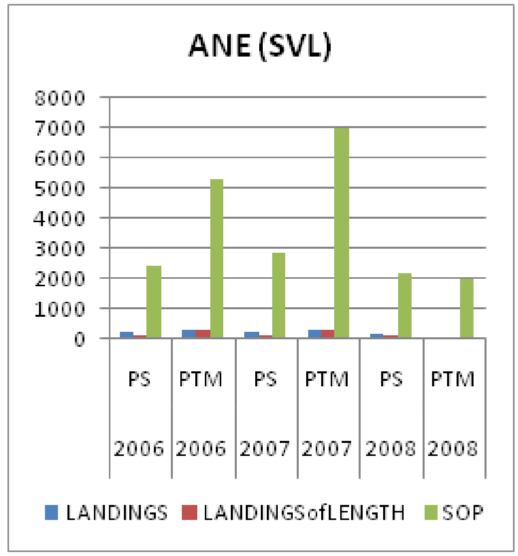
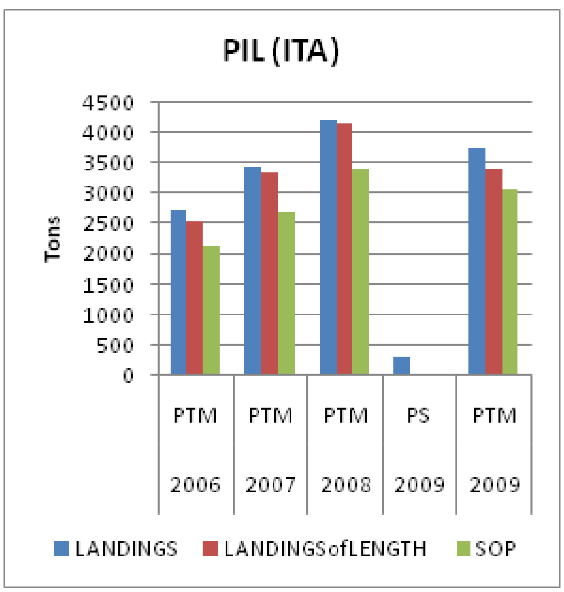


Figure 7.6.2.1. Differences between figures of Landing and Sumof Products (SOP) for anchovy (ANE).



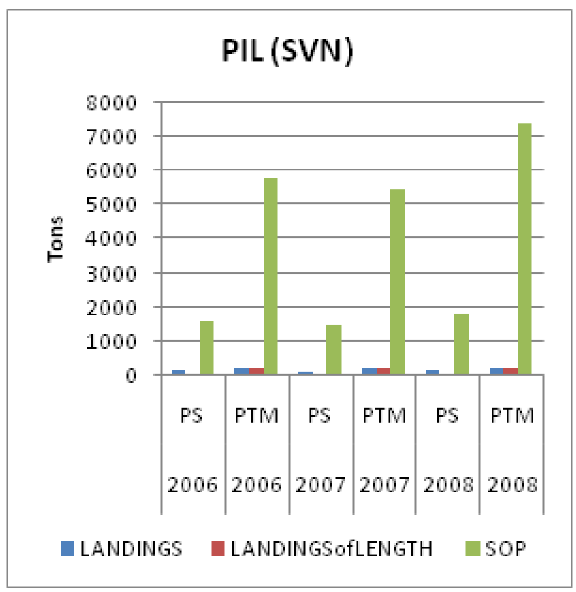


Fig. 7.6.2.2. Differences between figures of Landing and Sum of Products (SOP) for sardine (PIL).

Data on landings by length classes are available since 2006, but missing from SVN in 2009 for anchovy (ANE) and sardine (PIL) for all gears. Data on landings by length classes on sardine from ITA are available only for PTM gear, but missing for all other gears. Lack of PIL data by length classes for ITA concerning purse seine landings (PS) in 2006-2008 period can be highlighted.

7.6.3 Survey data (MEDIAS)

Data available from MEDIAS acoustic survey (N and biomass by age and length) on ANE and PIL are reported for ITA in 2009. Data for 2010 should be uploaded. No separate data from SVN are reported. Since acoustic survey is carried out by Italian R/V “Dallaporta”, it is believed that data from SVN are included in data set from ITA.

8 ToR G Empirical biologic indicators and methodologies for stock assessments lacking standard data requirements

8.1 Total mortality estimation using the SEINE method: the GSA 09 as a case study

Total mortality (Z) for several species historically not assessed in GSA 09 was estimated using a mean length approach derived by Gedamke & Hoenig (2006), which does not require equilibrium conditions. The fundamental concept is based on the same premise as the Beverton and Holt mortality estimator (1957):

$$Z = \frac{K(L_\infty - \bar{L})}{\bar{L} - L_c}$$

having the same minimal data requirements and therefore potentially useful for a widespread use. The only information required to obtain an estimate of Z is the von Bertalanffy growth parameters K and $L\infty$ (growth rate and length at infinite, respectively), the so-called length of first capture (smallest size at which animals are fully vulnerable to the fishery and to the sampling gear), L_c, and the mean length (L_{mean}) of the animals above L_c. The methodology and a practical application are described in detail in Gedamke & Hoenig (2006) and the method will only be described briefly here (see Cardinale et. al 2009 for an application of the method). The non-equilibrium formulation differs from the Beverton & Holt mortality estimator (1957) as it accounts for the different mortality histories experienced by fish of different ages. Thus, the assumption of equilibrium conditions (i.e. mortality has been constant for at least as long as the oldest animal in the population) is no longer a requirement of this approach. The model is able to predict mean lengths during the transition from one level of mortality to another and therefore allows for a time series of mean lengths to be evaluated. The approach was generalized to allow for multiple changes in mortality rate over time (see Appendix 2 in Gedamke & Hoenig 2006) and a maximum likelihood framework was used to estimate mortality rates and the years of change from the observed mean lengths. The model was implemented in AD Model Builder (Version 7.1.1, Otter Research Ltd. 2004), which in theory allows for an unlimited number of changes in mortality. The AIC (Akaike Information Criterion) was used to select the best model (Burnham & Anderson 2002). A fine scale grid search over starting values for each parameter was used to insure that a global solution was achieved. The model is freely available under the NOAA assessment tool website (http://nft.nefsc.noaa.gov/SEINE.html).

8.1.1 Input data

Annual mean length (L_{mean}) for each species analysed was calculated from the length frequency distribution estimated from MEDITS survey data in GSA 09 and using only individuals larger than L_c (i.e. those considered as fully selected by the gears used in the surveys). Annual mean length estimates are presented in Table 8.1.1.1. L_c was based on expert judgment on the species assessed in GSA 09 and by visual inspection of the length frequency distribution (Table 8.1.1.2). The von Bertalanffy parameters were derived from different sources and are presented in Table 8.1.1.2. The sample size (i.e. the number of individuals meshed for each year) for each species is presented in Table 8.1.1.3.

Table. 8.1.1.1. Annual mean length for each species calculated from the length frequency distribution estimated from MEDITS survey data in GSA 09 and using only individuals larger than L_c (i.e. those considered as fully selected by the gears used in the surveys).

Year	CITHMAC	LEPMBOS	MULLSUR	PAGEACA	SPICFLE	ZEUSFAB	MULLBAR	TRISCAP	LOPHBUD	MERLMER	TRACMED	PHYIBLE
1994	15.1	16.2	18.0	17.2	12.7	24.3	15.2	13.7	31.6	15.1	15.9	15.7
1995	15.5	16.3	18.6	15.5	10.1	23.5	14.4	13.6	31.6	13.6	16.4	14.8
1996	15.7	15.6	19.0	14.7	12.9	24.7	14.3	13.5	27.5	13.0	14.1	14.5
1997	15.3	14.5	15.7	12.0	10.4	24.3	14.2	13.3	30.2	12.2	15.4	15.4
1998	16.0	15.4	18.9	14.8	10.6	23.1	14.7	13.3	30.7	12.2	18.9	18.2
1999	15.4	16.9	17.7	15.6	9.9	23.5	14.9	13.4	33.3	13.2	14.6	13.5
2000	14.8	15.8	16.7	10.8	11.3	23.5	13.8	13.1	36.0	14.1	14.3	17.6
2001	16.2	15.5	14.3	16.7	11.5	26.4	13.9	14.0	39.2	14.0	14.0	18.2
2002	15.6	15.6	13.2	11.7	15.1	20.9	14.5	11.1	28.6	11.1	18.6	14.5
2003	14.9	16.7	18.4	11.3	11.4	26.7	13.8	13.2	26.5	12.0	15.9	15.5
2004	14.7	16.4	20.4	17.0	10.2	25.7	13.8	13.1	29.2	11.8	14.1	16.1
2005	14.9	15.7	18.5	18.9	12.3	26.6	13.0	13.2	29.9	12.6	17.5	14.8
2006	15.1	14.8	20.1	21.8	9.8	24.7	14.1	14.3	31.0	14.2	13.5	15.6
2007	13.6	15.1	13.8	14.5	10.8	20.5	11.8	12.0	35.9	12.2	14.0	16.1
2008	15.3	15.9	19.3	14.1	11.3	22.5	14.8	13.7	36.8	12.7	15.6	16.3
2009	14.9	17.5	18.0	12.2	12.9	23.3	14.8	12.5	36.8	11.8	13.7	15.4

Table 8.1.1.2. Von Bertalanffy growth parameters K and $L\infty$ (growth rate and length at infinite, respectively) and the so-called length of first capture (smallest size at which animals are fully vulnerable to the fishery and to the sampling gear), L_c.

Species	t0	k	$L\infty$	L_c	Source
CITHMAC	-0.04	0.25	33.0	10.0	Aegean Sea - Stergiou et al 1997
LEPMBOS	-1.06	0.19	38.0	11.0	Mannini et al 1990
MULLSUR	-0.40	0.43	32.0	8.0	SGMED 2010
PAGEACA	-1.16	0.28	30.4	6.0	Voliani et 2003
SPICFLE	-1.11	0.47	19.0	7.0	Zamboni e Relini 1986
ZEUSFAB	0.00	0.30	69.4	8.0	Righini e Voliani 1996,
MULLBAR	-0.10	0.60	29.0	8.0	SGMED 2010
TRISCAP	-0.01	0.42	24.1	8.0	VIVA TESI
LOPHBUD	-0.88	0.12	73.7	9.0	Saronikos Gulf - Stergiou et al 1997
TRACMED	-2.31	0.23	39.9	12.0	Saronikos Gulf - Stergiou et al 1997
MERLMER	0.00	0.20	104.0	10.0	SGMED 2010
PHYIBLE	0.03	0.23	66.0	11	GSA 9 REL GRUND 2003

Table 8.1.1.3. Number of fish measured per year to estimate average length for each species.

Year	CITHMAC	LEPMBOS	LOPHBUD	MULLSUR	PAGEACA	SPICFLE	TRACMED	ZEUSFAB	MERLMER	MULLBAR	PHYIBLE	TRISCAP
1994	113	134	55.0	49	56	1280	1007	112	5172	1148	858	784
1995	98	313	79.0	71	102	2612	513	159	8704	2146	1533	764
1996	25	262	101.0	44	96	764	1733	67	6274	2053	1602	310
1997	72	502	89.0	89	476	1400	1650	97	19457	2719	1756	566
1998	49	490	63.0	78	282	977	910	101	24619	2946	1411	521
1999	37	251	73.0	208	151	4295	2874	110	28250	3899	4270	534
2000	127	249	55.0	99	312	2480	8393	108	8873	3450	1987	544
2001	146	262	43.0	112	621	593	4124	82	4658	4105	972	622
2002	105	216	48.0	154	910	966	328	39	17697	2583	1917	417
2003	35	189	47.0	75	627	1433	1327	71	15484	4142	1269	337
2004	216	164	76.0	35	83	1492	449	41	14282	2665	1172	255
2005	136	97	37.0	31	61	402	84	60	10541	2084	1503	398
2006	30	136	58.0	27	227	2740	1063	76	8798	2443	1231	399
2007	317	373	67.0	96	551	1156	1625	81	8954	4382	873	527
2008	70	199	67.0	61	204	779	1951	69	11421	2136	848	203
2009	30	227	50.0	300	185	288	1687	94	14652	2201	1373	239

Due to the shortness of the time series (1994-2009), the SEINE method was run assuming only a single change in total mortality during the period analysed. First, we used the search grid option to derive the best estimate of Z_1, Z_2 and the year of change. The model with the lowest AIC was selected as the best model. Successively, the best model from the search grid was used to run the SEINE method and derive the final estimate of Z_1, Z_2 and the year of change.

8.1.2 Results

The species assessed using the SEINE method were *Citharus linguatuala* (CITALIN), *Lepidorhombus boscii* (LEPIBOS), *Mullus barbatus* (MULLBAR), *Mullus surmuletus* (MULLSUR), *Pagellus acarne* (PAGEACA), *Spicara flexuosa* (SPICFLE), *Trisopterus capelanus* (TRISCAP), *Zeus faber* (ZEUSFAB), *Lophius budegassa* (LOPHBUD), *Trachurus trachurus* (TRACTRA), *Merluccius merluccius* (MERLMER) and *Phycis blennoides* (PHYIBLE). The stastics of the best models for each of the species analysed are presented in Table 8.1.2.1.

Table 8.1.2.1. Results of the SEINE method for twelve species sampled by MEDITS in GSA 09: *Citharus linguatuala* (CITALIN), *Lepidorhombus boscii* (LEPIBOS), *Mullus barbatus* (MULLBAR), *Mullus surmuletus* (MULLSUR), *Pagellus acarne* (PAGEACA), *Spicara flexuosa* (SPICFLE), Trisopterus capelanus (TRISCAP) and *Zeus faber* (ZEUSFAB), *Lophius budegassa* (LOPHBUD), *Trachurus trachurus* (TRACTRA), Merluccius merluccius (MERLMER) and *Phycis blennoides* (PHYIBLE).

CITALIN	Value	St dev	LEPIBOS	Value	St dev	TRISCAP	Value	St dev
Z1	0.8	0.0	Z1	1.0	0.1	Z1	0.8	0.1
Z2	1.1	0.1	Z2	0.9	0.1	Z2	1.0	0.1
Year1	2002	0.9	Year1	1997	0.8	Year1	1999	2.7
Sigma	5.3	0.9	Sigma	10.4	1.8	Sigma	14.9	2.6
AIC	106.6		AIC	128.8		AIC	139.7	
Likelihood	49.3		Likelihood	60.4		Likelihood	65.9	
MULLBAR	Value	St dev	MULLSUR	Value	St dev	ZEUSFAB	Value	St dev
Z1	1.3	0.1	Z1	0.8	0.1	Z1	0.8	0.0
Z2	1.6	0.1	Z2	0.4	0.3	Z2	1.0	0.1
Year1	1999	0.7	Year1	2007	0.9	Year1	2005	0.6
Sigma	40.2	7.1	Sigma	19.3	3.4	Sigma	12.9	2.3
AIC	171.6		AIC	148		AIC	135.2	
Likelihood	81.8		Likelihood	70		Likelihood	63.6	
PAGEACA	Value	St dev	SPICFLE	Value	St dev	LOPHBUD	Value	St dev
Z1	0.6	0.1	Z1	1.1	0.2	Z1	0.2	0.0
Z2	0.2	769.0	Z2	0.9	0.2	Z2	0.0	0.0
Year1	2009	1.6	Year1	1999	1.3	Year1	2 004	1.1
Sigma	48.1	8.5	Sigma	48.0	8.5	Sigma	47.6	8.4
AIC	177.3		AIC	177.7		AIC	176.6	
Likelihood	84.6		Likelihood	84.4		Likelihood	84.9	
TRACMED	Value	St dev	MERLMER	Value	St dev	PHYIBLE	Value	St dev
Z1	1.5	0.3	Z1	3.5	1.6	Z1	3.0	0.4
Z2	2.5	0.3	Z2	5.0	0.0	Z2	2.4	0.3
Year1	1998	0.3	Year1	1994	0.0	Year1	1999	0.3
Sigma	43.0	7.6	Sigma	155.6	27.5	Sigma	52.7	9.3
AIC	173.7		AIC	214.9		AIC	180.2	
Likelihood	82.8		Likelihood	103.4		Likelihood	86.1	

The observed and predicted annual mean length and the estimated Z is presented for each species in Figure 8.1.2.1. For several species never assessed before, the method was able to derive reasonable estimate of Z. For CITLIN, LEPIBOS, ZEUSFAB, SPICFLE estimate of Z were around 1.0, with only small changes during the time series analysed. We did not observe a consistency among the year of change between species, ranging from 1997 to 2009. Some of the species analysed with the SEINE method were also assessed using analytical methods (e.g. VIT or XSA). Those species were used to compare estimate of Z with different methods. TRISMIN gave an estimate of Z around 1.0 that is larger than what has been estimated using SURBA analysis (this report) while the estimate of Z for MULLBAR was very similar on what estimated by SGMED using different analystical methods as SURBA, ASPIC and VIT (SGMED 10-03 report, Mazzara). For MULLSUR, SEINE method gives a much lower estimate of Z that estimated by (this report). It is also evident that for species where the adults are not caught by the gear used here (i.e. MERLMER, PHYIBLE), the method gives unrealistic high estimate of Z (i.e. between 2.4-5.0) while the XSA model run in 2010 (SGMED 2010, Mazzara), gives a Z estimate between 1.5 and 2. On the other hand, for LOPHBUD and PAGEACA, estimates are unrealistically low. For LOPHBUD, this could be due to fact that the few individuals caught during MEDITS are usually only large fish. TRACTRA gave instead large estimate of Z that might be due to high values of natural mortality (M) although we do not have other independent estimate to compare the Z values derived from the SEINE method.

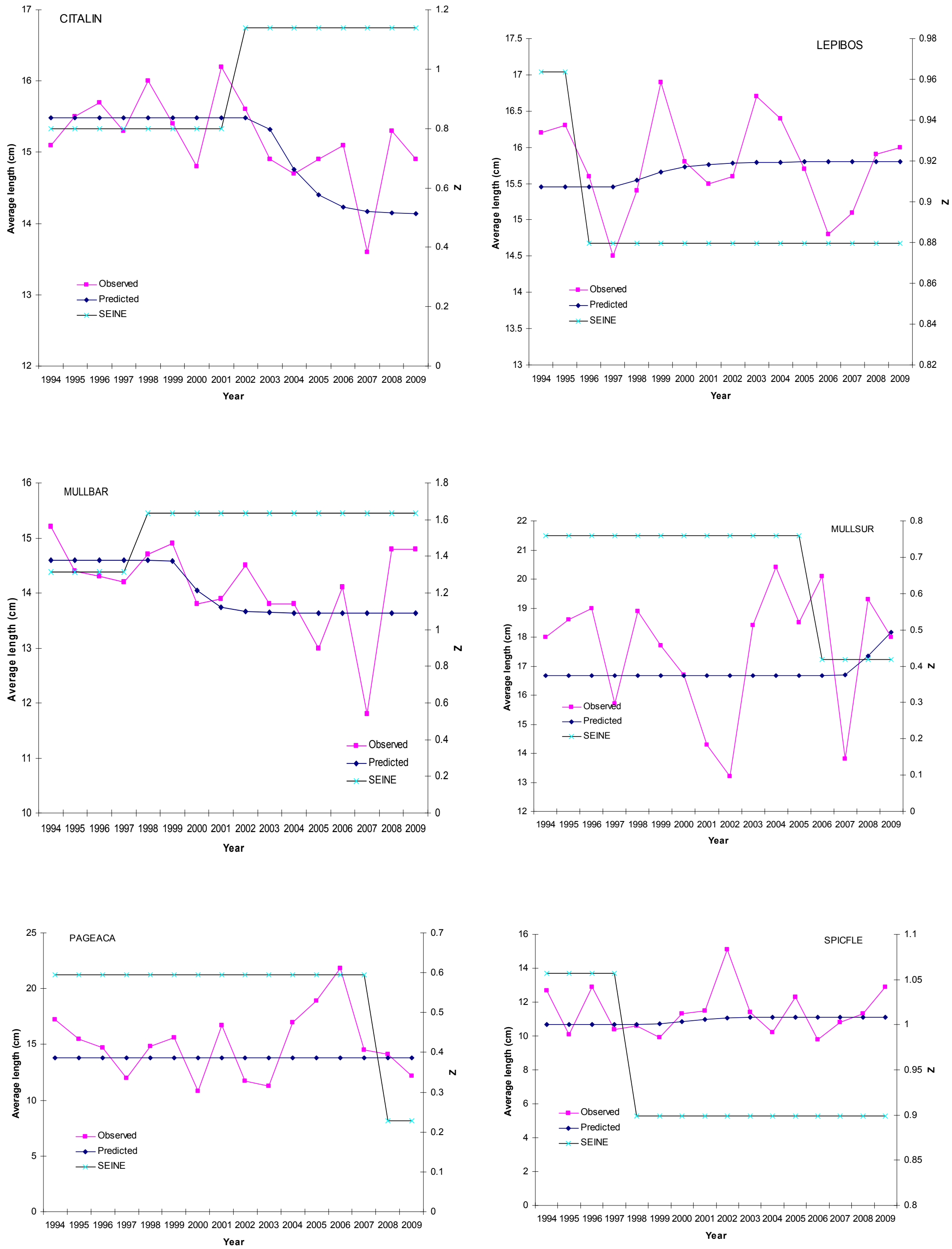


Figure 8.1.2.1. Observed and predicted annual mean length with the estimate Z over the time series.

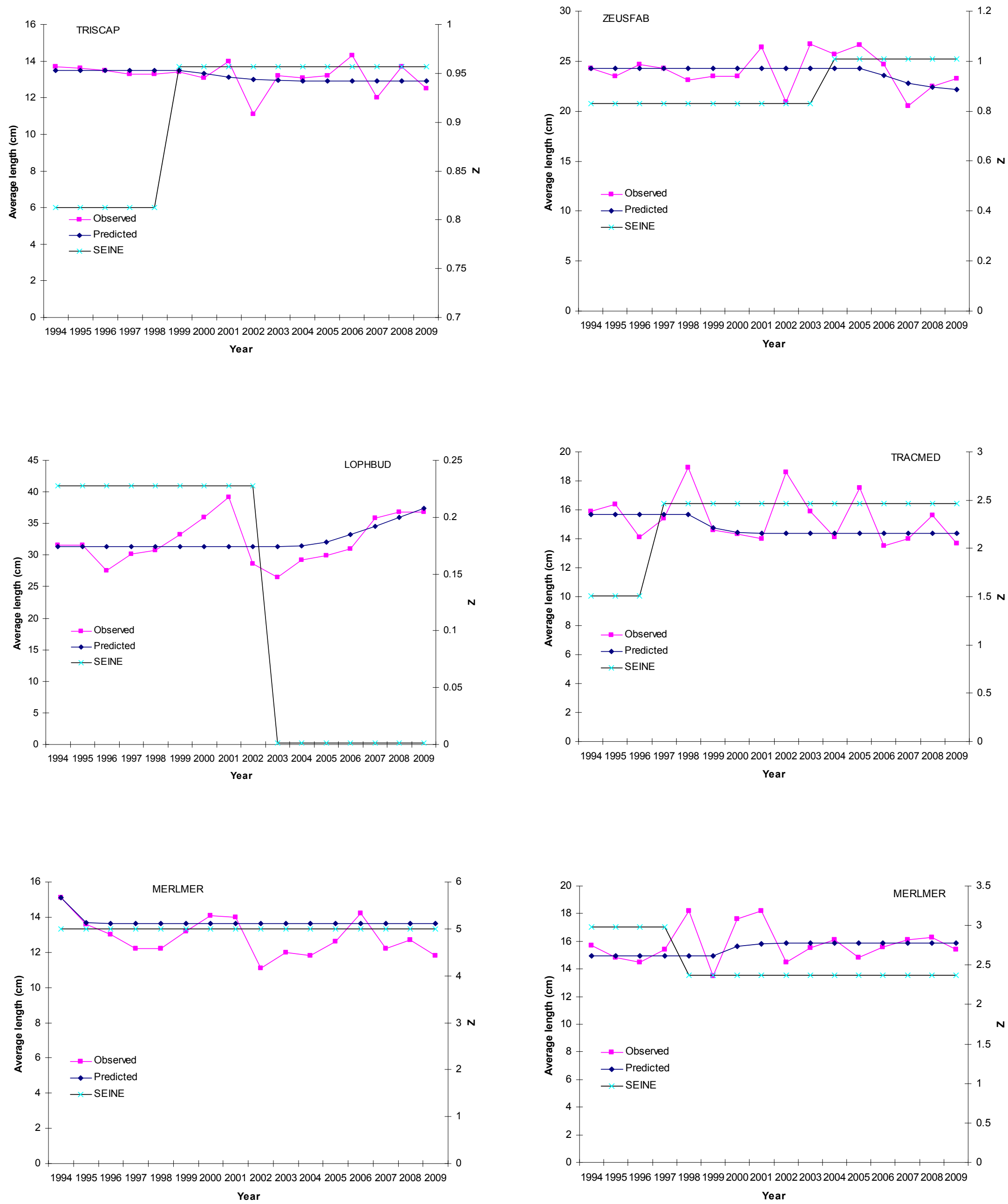


Figure 8.1.2.1. Continued, observed and predicted annual mean length with the estimate Z over the time series.

8.1.3 Conclusions

EWG 11-05 concludes that the SEINE method is a rather simple, less data demanding method that in theory could be used to derive estimate of Z for any species with length data from survey or from commercial catches. Having a minimal data requirement, it has also the potential for a widespread use in data poor situation as it is the case for several species exploited in the Mediterranean Sea. However, it is also clear that its use is not suitable for those species that are not representatively sampled (i.e. the collected sample is not a random sample of the population) by the gear used to derive the time series of annual mean length as for example large gadoids as MERLMER and PHYIBLE, where adults are not consistently sampled or as for LOPHBUD where only few large fish but no juveniles are usually caught. For species where estimates obtained with other methods as VIT or XSA were available, the comparison revealed a good consistency for MULLBAR but an underestimation of Z for TRISMIN and MULLSUR.

In general, EWG 11-05 considers the SEINE method a simple, efficient method to estimate total mortality rates for all species assuming that the annual mean length are derived from a random sample of the population. Thus, it is crucial to make an a priori evaluation of the length frequency distribution from which the annual mean length data are estimated and also how the different length/age classes of the population are representatively sampled by the gear used. In general, EWG 11-05 concludes that for small sized species where both adults and juveniles are effectively sampled by the gear, the SEINE method has the potential to provide robust estimate of Z and detect eventual temporal changes in mortality rates. On the other hand, the method is less suitable for large sized species or for species where juvenile or adults are not caught by the gear used.

9 ToR H Computer program R-scripts to evaluate MEDITS and other CPUE data series

EWG 11-05 was requested to further develop and test the developed R scripts to facilitate the evaluation of both survey and commercial data series. In the absence of appropriate expertise EWG 11-05 was unable to address the task to further develop and test the developed R scripts to facilitate the evaluation of both survey and commercial data series, and EWG 11-05 recommends to defer the task to future meetings.

10 ToR I Frameworks to deliver management advice for multi-species/stocks fisheries

10.1 Introduction

EWG 11-05 noted that the great majority of Mediterranean stocks are exploited by multi-species (mixed) fisheries, particularly the near bottom and bottom dwelling species due to their coexistence in diverse communities and the poor selectivity of many gears used. Still, the variety of exploited stocks in mixed fisheries requires specific conservation needs as defined by the Marine Strategy Framework Directive (EU 2008) based on the specific ecological role and stock status (Piet et al., 2010). It is further noted, that the selection of the various mixed fisheries involved in the exploitation of certain stocks potentially varies with the areas, gears and the fishing strategies. It is argued that the mixed fisheries are best managed by fishing effort, if they deploy trawled (active) gears. This can be done by settings of maximum allowable effort (TAE) in units of days at sea or the product of kilo Watt times days at sea to account for boat specific fishing power. The applicability of such effort measures regarding passive demersal gears has still to be proven. Fishing grounds with high stratification, e.g. along continental shelves, may force certain stocks or parts of them to occur highly aggregated and thus make pure effort measures ineffective to control fishing mortality, like in the example of pelagic fisheries. However, catch figures estimated and set consistently with effort constraints (TAE) will help to communicate foreseen constraints in fishing possibilities to the involved stakeholders.

10.2 Description of existing models

10.2.1 F-cube

EWG 11-05 notes that ICES has established a dedicated working group which has developed software to evaluate mixed fisheries scenarios and management options, the so-called F-cube approach. However, this software (Ulrich et al., 2011) is specifically designed for short term forecasts (for the running and one future year) and not age specific. As such, medium term and selection effects cannot be simulated and short term advice might be biased in cases of recruitment events.

10.2.2 Approach by A. Abella

Alvaro Abella has presented his joint publication (Abella *et al*, 2010) which presents a mixed fisheries assessment approach based on non-equilibrium simulations of stock size, exploitation and yield. The study regards the group of vessels, operating near the coast that targets a multispecific groundfish assemblage. The analysis is based on a biomass dynamic model and is aimed at the definition of the Maximum Sustainable Yield and F_{MSY}. The analyses were performed using the ASPIC software (Prager, 1994, 2005). This program implements a non-equilibrium, continuous-time, observation-error estimator for the production model (Schnute, 1977; Prager, 1994). The approach allows specific short and medium term advice. The population estimates calculated by the surplus production model were used to project the population forward in time for a period of 10 years at different levels of *F* to evaluate changes in biomass and potential harvest levels. The evaluation of trends in relative biomass over time for a range of fishing mortality levels were performed as proportional reductions of the mortality rate. The level of biomass reached at the end of the forecasting time period under different harvesting scenarios was assessed, as well as the number of years required for the population (including 80% confidence intervals) to rebuild to B_{MSY}. According to the results derived from the surplus production model runs, the current levels of fishing effort and *F* for the single species and for the species mix resulted much higher than their corresponding f_{MSY} and F_{MSY}. The demersal assemblage appears severely depleted and even though a reduction of fishing effort have occurred, the maintenance of the current harvest levels is too high to allow the stocks to rebuild to B_{MSY}. Abundance enhancements are predicted with the forecasting routine for almost all the species in the case effort be kept at the level of the last year. Projections for some of the species suggest a relatively fast population recovery in the case effort be reduced. Simulations suggest that a 40% reduction of fishing effort should be needed for driving biomass for almost all the species at or over the *MSY* levels

10.2.3 Approach by H.-J. Rätz

Hans-Joachim Rätz introduced a stochastic medium term forecast model for mixed fisheries (maximum 10 stocks, 10 fisheries) provides quantitative conclusions on future catch and biomass trends under various management scenarios over medium term (10 years) (Rätz et al. 2007).

The STECF EWG 11-05 undertook a detailed exploratory analysis of the mixed demersal fisheries in GSA 9. Four fisheries are defined being engaged in the catch of four stocks. The analyses undertaken are meant to support the management with options regarding the design of multiannual management plans towards sustainable fisheries.

10.2.3.1 Model description and settings

The model is formulated as a MICROSOFT EXCEL workbook with embedded macros, using VISUAL BASIC for applications as program language. The model is age specific for both landed and discarded portions of the catch. For each stock and fishery the requested inputs have to be specified in yellow shaded cells. 100 iterations are performed in order to quantify the variation of the model results.

The major underlying dynamic concept is defined as

$$N_{y+1,a+1} = N_{y,a} \exp(-(M_{y,a} + F_{y,a})) \qquad (1),$$

where N denotes stock size in numbers in given year y at age a, M equals natural mortality and F fishing mortality Beverton and Holt (1957).

The most important stock productivity parameter is the recruitment to the stock

$$R = \alpha S \exp(-\beta S) \qquad (2),$$

where R denotes the recruitment to the stock, S the parental stock size with α and β as stock specific parameters (Ricker, 1975).

Finally, the catch equation links the observed catches taken from a given stock with the stock size and the two components of mortality, i.e. the natural and the fishing mortality as

$$C_{y,a} = F_{y,a} N_{y,a} ((1-\exp(-(F_{y,a} + M_{y,a}))) / (F_{y,a} + M_{y,a})) \qquad (3)$$

where C denotes catch in numbers in a given year y at age a (Beverton and Holt, 1957).

Stock specific production parameters (weight at age, recruitment, fishing mortality) required and the limit reference management levels have to be defined. The matrix of actual contributions in terms of fishing mortalities (partial fishing mortality F) by stock and each fishery has to be given. The fisheries are defined as harvest activities which share certain stocks in the same management areas. The more complete the catch composition is covered, the more representative the results are.

The application of the program starts with the definition of the mixed fisheries over the significant stocks and the significant fisheries to the overall catch, each set as a maximum of 10 (start page). Then the start year of the medium term simulation shall be defined.

In order to allow for a simulation of evolving fisheries in an unexploited ecosystem, the program allows for a reduction of the defined selectivity by 90 %, treating the defined selection pattern as relative. As this is not the normal situation, it is recommended to keep the default setting as “n” (=no).

The following options allow managing the future catch possibilities under two different options. Either all stocks’ Ftargets shall simultaneously constrain the fishery or only one (highest) Ftarget decisive. Under the first option as “a” (=all), there would be no overquota catches for none of the stocks in the mixed fisheries allowed. While all stock specific conservation needs are respected, the majority of the fishing possibilities from individual stocks would not be completely taken. Under the second option as “h” (=high), the fishing activities would only be ceased after the fishing possibilities from all individual stocks have been accomplished. This implies high overquota catches (discards in case of landing restrictions) in access of the many stock specific conservation needs.

The easiest approach to deal with mixed fisheries management is treat all defined fisheries proportionally, their F impact and resulting catch possibilities would change proportionally. This is done with the following two parameter setting. Now, the first of the two parameters allows to quantify the threshold at which fisheries are subject to specific measures through the ration F/Ftar >= X. The lower the value, the more of the less contributing fisheries will be considered in the mixed fisheries scenarios. The fisheries below the defined ratio will not be subject to such specific measures. The second parameter specifies a maximum relative change in partial F, which a fishery shall accept. Is the maximum annual change of fisheries’ partial F factor =0, then there is no fisheries specific management applied (default). If the factor is set for example at 0.2, the annual maximum change in F would be ± 20%. In this case, the fisheries disproportional specific factor to the F will be applied, e.g. by favoring fisheries avoiding overfished stocks or selecting less stocks from the ecosystem (Rätz *et al.*, 2007). Focusing exclusively on the exerted fleet specific impact expressed as the ratio between fishing mortality in relation to the sustainable management limit on a stock by stock basis, the fisheries specific F of all stocks will be assigned a specific relative factor according to the formula

$$fac_{fishery} = (P / \Sigma (F_{fishery} / F_{MSY})) / (\Sigma (P / \Sigma (F_{fishery} / F_{MSY})) / L) \qquad (4),$$

where $fac_{fishery}$ denotes a fisheries specific weighing factor, P the number of stocks caught by a given fishery and L the number of fisheries. $F_{fishery}$ quantifies the fishing mortality exerted by specific fishery, known as the partial fishing mortality. Such factor $fac_{fishery}$ would be relatively low if a given fishery contributes more to overfishing than other fisheries. Contrarily, fisheries contributing less to the risk of overfishing would be assigned a relatively high factor which could be then applied to allow for an increased impact of such fisheries, i.e. their partial fishing mortality determining the specific fishing possibilities of future years.

Following the definition of the above described mixed fisheries management rules on the start page, the stock specific parameters have to be defined on a stock by stock level. The structure of the stock specific sheets “stock1inp” to “stock10inp” is identical. First of all, the range of age groups of data (youngest and oldest) and the range of age groups to estimate the reference F is to be defined. Then for each age group the weight at age in the stock, proportion mature and natural mortality M (10 years historic averages) has to be defined, as well as a recent the most recent stock size in numbers (thousands, 1 January in the start year of the simulation). Then the specific Ricker's stock recruitment parameters a and k have to be quantified in order to allow the program to stochastically generate future recruitment. The 5 % quantile recruitment (minimum) is a recruitment threshold which limits the lowest recruitment possible. The recruitment relative variation CV is the coefficient of variation observed in the time series of recruits estimated, which defines the variation of the generated recruitment. The Bpa (t) Bmsy trigger is a reference value to evaluate the stock status, usually a level without impeded recruitment. The parameter F target management plan defines the upper limit of sustainable exploitation, often defined as Fmsy or its proxy. The relative parameter 'Rel. max. annual change Fref' limits the annual variation of F to reach the management reference point. The relative 'parameter Rel. max. annual change TAC' stipulates the maximum change in total allowable landings. This option is inactive in the present workbook, as the option implies conflict with the maximum annual change in F in a multispecies context.

For each age group and fishery the partial fishing mortality F on landings, the mean weight of the landings, the partial fishing mortality F on discards and the mean weight of the landings has to be provided on the right hand side of each of the stock specific input pages. For numerical reasons it is requested that each of the stock is harvested by each of the fisheries defined. It is therefore recommended to define very low partial fishing mortalities (F=0.001) for fisheries which do not contribute to the catch.

For most of the parameters it is possible to define a random variation by a coefficient of variation (CV) and for some of the parameters there can be defined a relative level of bias, negative or positive, the default is no bias =0.

10.2.3.2 Data used in the exemplary GSA 9 mixed demersal fisheries evaluation

The dominant otter trawl fishery 'OTB' is the major contributor to the exploitation of 3 out of the 4 stocks, namely European hake (HKE), Norway lobster (NEP) and red mullet (MUT). The pink shrimp (DPS) fishery is called 'OTB dps' and is considered to be conducted in very clean way without major by-catch, given the potential selection devices available. 30% of the HKE and only 4 % of the MUT are taken also by the gill nets (GNS), while no DPS and no NEP are selected. The trammel fishery 'GTR' has a minor impact on MUT only.

The technical interactions of the four fisheries regarding the exploitation of the four stocks are quantitatively expressed in terms partial fishing mortalities and listed in Table 9.2.3.2.1. Table 9.2.3.2.1 also allows the stock status evaluation with regard to the sustainable Fmsy. All values adopted were estimated and reported by STECF-SGMED 10-03 and by the STECF expert working group EWG 11-05. It becomes clear that three of the stocks, HKE, NEP and MUT are overfished, with HKE being the heaviest case. Only the DPS is considered to be sustainably exploited. In summary, three of the demersal fisheries contribute to the harvest of the overexploited stocks, with the 'GTR' having the lowest impact regarding fishing pressure. This fact is illustrated by the red marked cells in Table 1 indicating fisheries specific partial fishing mortalities in excess of Fmsy. Only the fishery 'OTB dps' targeting DPS with negligible by-catch of other stocks is regarded sustainable.

The essential stock specific parameters to simulate the stock dynamics and the parameter specific variation in terms of coefficient of variance are given in Table 9.2.3.2.2. Due to shortage of data series the dynamics of the involved stocks are poorly known, in particular the recruitment variation. The parameters are chosen also to minimize the direct impact of stock sizes below levels that imply impaired recruitment. Due to the very low stock size this was not fully achieved for HKE. Figure 9.2.3.2.1 displays the estimated spawning stock biomass (SSB) and resulting recruitment (R) of the 4 stocks, respectively.

The model used provides iterations (100) of medium term stochastic forecasts of fisheries and age specific stock size, landings, discards and fishing mortalities. The model description can be found in previous section of this report.

The general goal of the applied multi-annual management plan (harvest control rule) is to sustainably exploit all four stocks. This is planned to be realized by a maximum annual change in fishing mortality F by ±10%. In the case of overfishing (F>Flim), the F in the future year will be reduced by a maximum of 10 % or to Flim, in case of sustainable exploitation, the F in the following year is increased by a maximum or 10% or to Flim. The Fmsy of the four stocks is adopted as the limit of exploitation Flim in the management plan. Three scenarios to explore the mixed fisheries effects were conditioned as:

Scenario 1: Only one stock specific Flim is constraining the fisheries, which is the highest. This implies catches beyond the stock specific conservation needs. There is no fisheries specific management, the effort of all fisheries contributing more than 1% to any F varies proportionally.

Scenario 2: All four stock specific Flim are constraining the fisheries, the lowest F will actually be effective. This implies loss of potential catches of the other stocks. There is no fisheries specific management, the effort of all fisheries contributing more than 1% to any F varies proportionally.

Scenario 3: All four stock specific Flim are constraining the fisheries, the lowest F will actually be effective. This implies loss of potential catches of the other stocks. To minimize such losses, fisheries specific management is allowed to affect the fisheries according to their impact on overfishing, the effort of all fisheries contributing more than 1% to any F shall varies disproportionally. Such annual variation in fisheries specific F is constrained by a factor of 2.

Table 9.2.3.2.1 Partial fishing mortalities of four fisheries of four stocks of European hake (HKE), pink shrimp (DPS), Norway lobster (NEP) and red mullet (MUT). The values are also given in relative terms versus the sum of fishing mortalities and checked against sustainable levels. Red cells indicate relative partial fishing mortalities in excess of Fmsy (>1).

Fishery	HKE	DPS	NEP	MUT
OTB	0.736	0.001	0.62	0.602
OTB dps	0.001	0.653	0.001	0.001
GNS	0.319	0.001	0.001	0.024
GTR	0.002	0.001	0.001	0.037
SUM	1.058	0.656	0.623	0.664
Fmsy	0.22	0.7	0.21	0.4
relative to F SUM				
OTB	0.696	0.002	0.995	0.907
OTB dps	0.001	0.995	0.002	0.002
GNS	0.302	0.002	0.002	0.036
GTR	0.002	0.002	0.002	0.056
SUM	1	1	1	1
relative to Fmsy				
OTB	3.345	0.001	2.952	1.505
OTB dps	0.005	0.933	0.005	0.003
GNS	1.451	0.001	0.005	0.06
GTR	0.009	0.001	0.005	0.093

Table 9.2.3.2.2 Essential stock specific parameters to simulate the stock dynamics and the parameter specific variation in terms of coefficient of variance.

Stock	Age range (years)	Fref age range (years)	Ricker a	Ricker k	CV
HKE	0-5	1-4	7.5	15,000	0.5
DPS	0-4	1-4	745	750	0.5
NEP	0-9	3-7	250	380	0.5
MUT	0-4	1-4	240	125	0.5

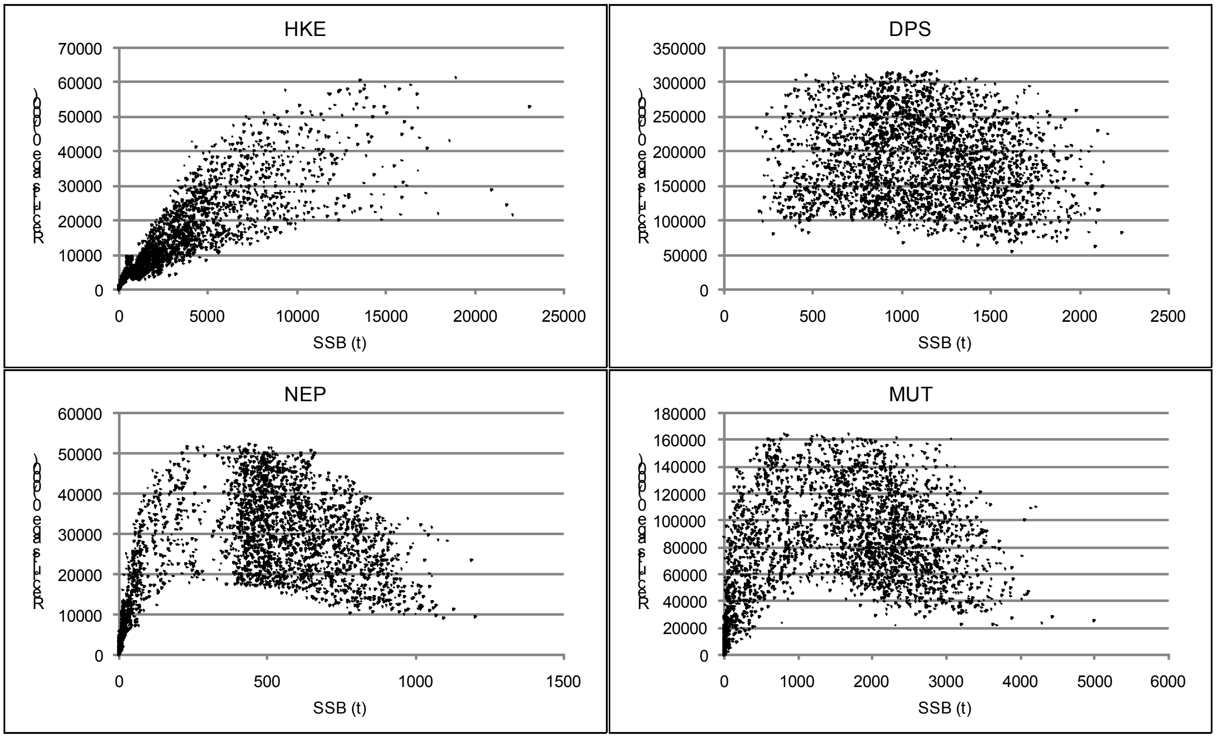


Figure 9.2.3.2.1 Spawning stock-recruitment simulations as used in the medium term projections for HKE, DPS, NEP and MUT.

10.2.3.3 Results and discussion

STECF EWG 11-05 noted that the catch composition of the four fisheries is quantitatively considered for four stocks only, while the catch compositions of these fisheries are expected to be more diverse and composed of more stocks. As such, STECF EWG 11-05 considers the definitions of the demersal fisheries as well as the results of presented the mixed fisheries simulations as illustrative and not representative. Secondly, the parameters describing the population dynamics and productivity of these four stocks are believed to be uncertain due to lack of knowledge. However, the overall situation is that three out of four defined fisheries 'OTB', 'GNS' and 'GTR' contribute to heavy overfishing, in particular of HKE, NEP and MUT. Trammel nets 'GTR' are of very minor importance and mainly target MUT while the selective shrimp fishery 'OTB dps' only catches the pink shrimp DPS in a sustainable manner. As such it appears logic that, pending on the chosen management criteria, the fisheries need to decrease their impact drastically through significant effort reductions.

Scenario 1: Constraining the fisheries by only one fishing mortality F of one specific stock implies that the management goal to sustainably exploit all four stocks is likely to be failed (Fig. 9.2.3.3.1). It appears that HKE is in many cases the constraining stock in the management decisions. The uptake of catch possibilities derived from maximum fishing mortalities (fishing effort) of four stocks under the regime of one stock will generally lead to further decreases in stock sizes and catches of three stocks in excess of their specific conservation needs. Only DPS, whose productivity is resistant against SSB reductions in particular (Fig. 9.2.3.2.1), would not react negatively on excessive fishing. All four fisheries are projected to increase their efforts over the whole period in order to fully uptake their individual stock specific catch possibilities.

Scenario 2: All four stock specific F limits in exploitation are realized as the fishing mortalities are significantly reduced by 2015. In fact, it appears that the rule to simultaneously exploit the stocks in a sustainable manner quickly leads towards the situation where one stock of poor productivity causes large amounts of catch possibilities of the other productive stocks not being taken. This is the reason for the indicated quick and continued reduction in median fishing mortality of all four stocks and median fishing effort of all the four fisheries (Fig. 9.2.3.3.2), even at a much higher rate than 10% as defined in the management plan where necessary. However, a problem would arise from defending the management decision regarding a reduction of the fisheries 'GTR' and 'OTB dps' despite their minor or no impact to overfishing, respectively. As the logical result of this management simulation, the SSBs of the four stocks are quickly recovering as the catches decrease during the future ten years.

Scenario 3: The results of the only scenario, which allows for fisheries specific management, are rather similar to scenario 2. This can be explained by the fact, that the situation of exploitation is significant of three out of four stocks and that three of the four fisheries contribute to this poor situation. Only the catch profile of the fishery, which exclusively and sustainably target DPS, allows for an unchanged fishing mortality F and lower reduction in effort (Fig. 9.2.3.3.3) followed by a stable situation. The other fisheries would consistently and sharply reduce their impact through a consistent and significant reduction in F and in effort, which is a consequence of their higher contribution to overfishing. This decoupling of the 'OTB dps' in the simulated fisheries management scheme leads to a higher recovery potential of HKE and a slightly better uptake of the catch possibilities of all four stocks.

Based on the outcome of the presented exploratory results and in order to take advantage of fisheries specific effects, the STECF EWG 11-05 recommends that the design of a multi-annual management plan for demersal fisheries in GSA 9, in addition to a significant reduction in the effort of all fisheries, shall consider the option of a disproportional and fisheries specific approach to optimize catch options consistent with conservation requirements and fishing effort deployed. STECF EWG 11-05 further recommends that the potential use of existing devices to improve the selectivity of mixed fisheries shall be evaluated and promoted in order to simplify overly complex fisheries strategies through reduction of by-catch.

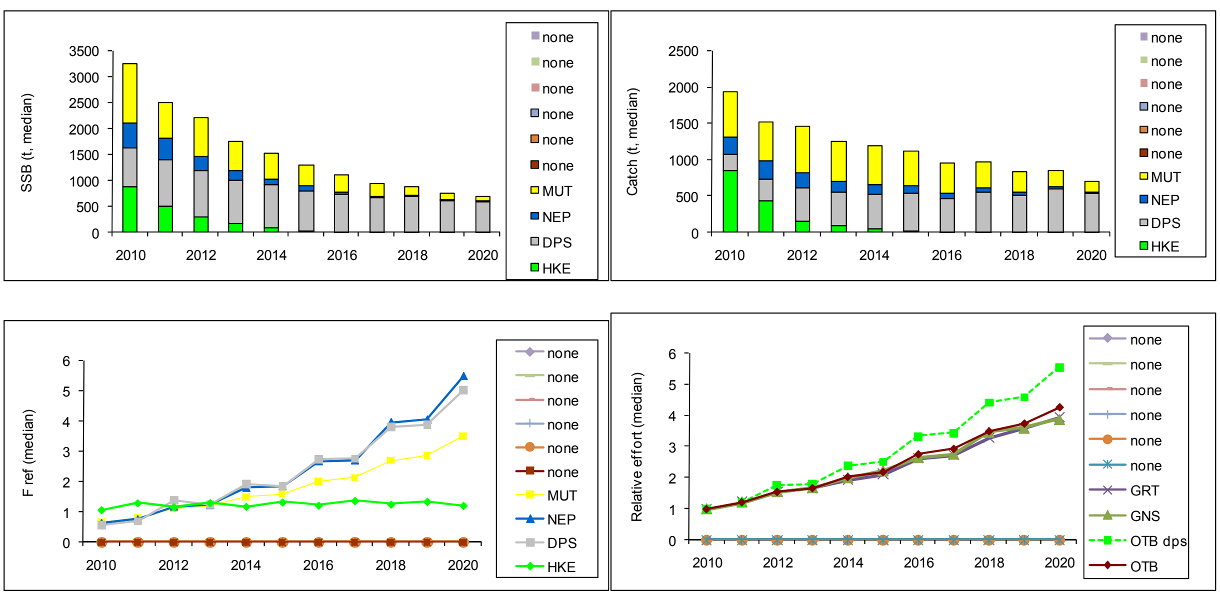


Fig. 9.2.3.3.1 Scenario 1: Median trends in SSB, catch, fishing mortality F and relative fishing effort.

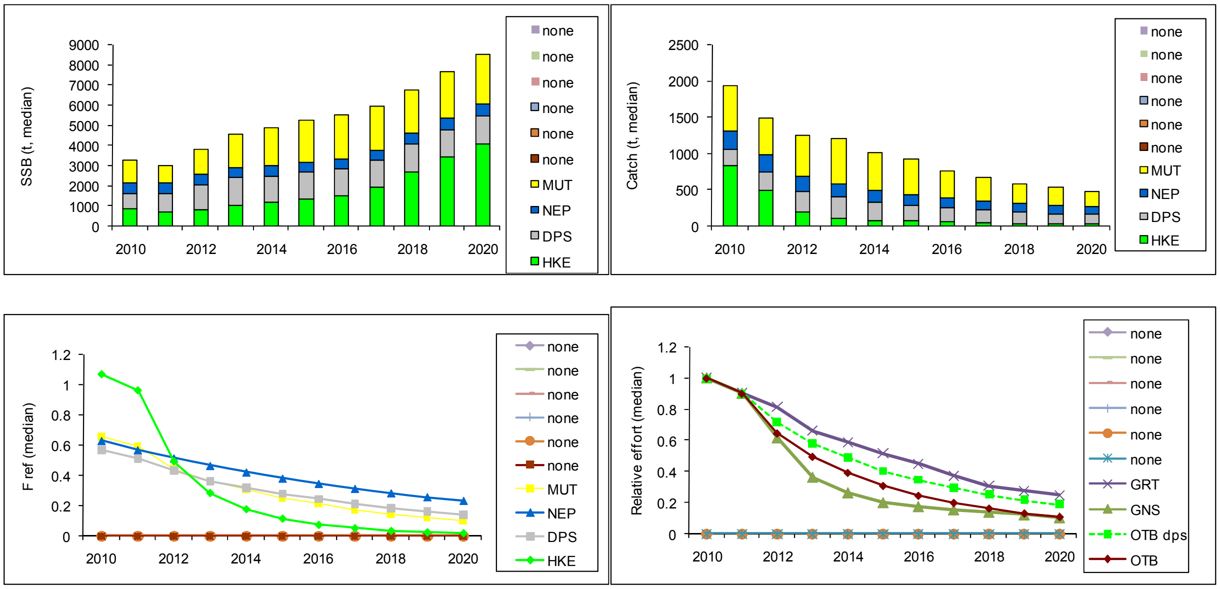


Fig. 9.2.3.3.2 Scenario 2: Median trends in SSB, catch, fishing mortality F and relative fishing effort.

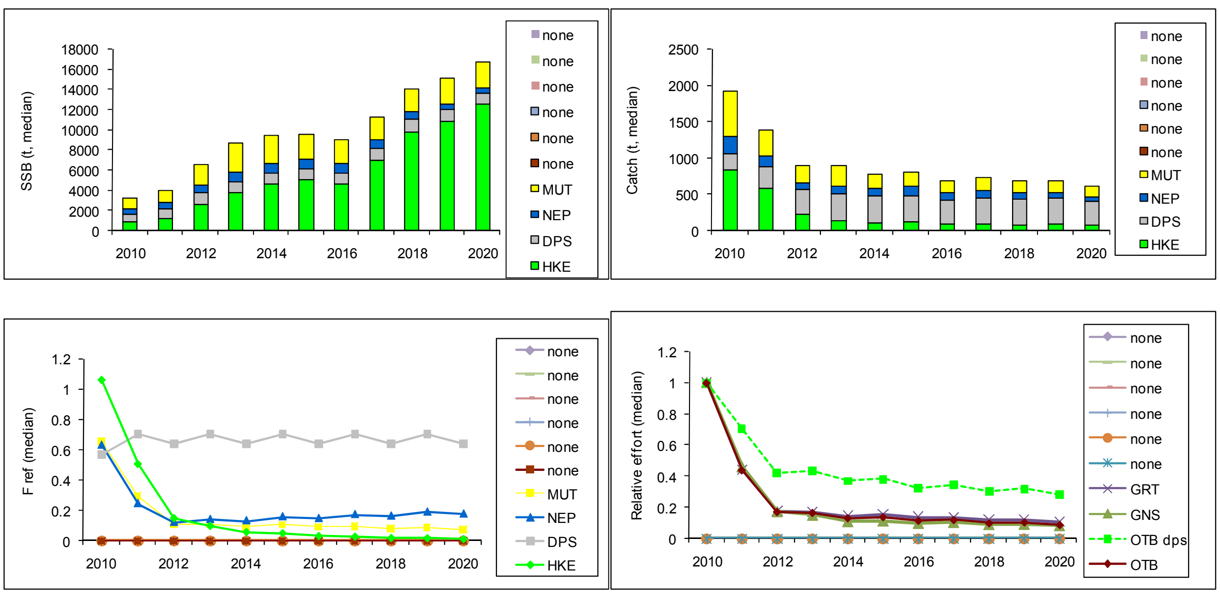


Fig. 9.2.3.3.3 Scenario 3: Median trends in SSB, catch, fishing mortality F and relative fishing effort.

10.2.4 Productivity and Susceptibility Analysis

An assessment of the sustainability of by-catch species in the Norway lobster fishery off Viareggio (South-Eastern Ligurian Sea) using productivity and susceptibility indices was illustrated by Alvaro Abella.

In situations where a quantitative stock assessment is not feasible due to a general shortage on the historical and biological information on stocks, it is possible to use the software PSA (Productivity and Susceptibility Analysis) developed by Stobutzki *et al* (2001) aimed at examining the impact of the fishery targeting certain species on the fishery's by-catch.

The by-catch species are assessed as regards their level of susceptibility to be captured with the consequent mortality impact and on their capacity to recover after depletion based on considerations on productivity. In the example presented, the analysis has been done for the 15 species that represent about the 85% of the total landings of the fishery in weight.

It is a semi-quantitative approach that is considered very useful for examining the vulnerability of stocks. It is currently used by several organizations and working groups around the world as an approach for determining vulnerability and risk of driving stocks to unsustainable levels.The two elements fundamental for determining vulnerability are the stock productivity (mainly dependent on life-history characteristics and related with the capacity of the stock to fast recover when is at low values of abundance and the stock susceptibility, that is the potential of a stock to be negatively impacted by a fishery. PSA assumes that the species in a fishery will be at risk if they are characterised by a low productivity, that implies long recovery times and/or if they are very susceptible (they are highly exposed) to the fishing activity.

Several units of analysis that include indicators linked to productivity and susceptibility are used.

The results obtained are consistent with the limited knowledge of the involved stocks and allowed an assessment of vulnerability and risk of overexploitation of several not well known stocks in the Norway lobster fishery by-catch. The defined vulnerability ranking is particularly useful for giving priority for research and management for those species considered more exposed to the fishery and less resilient. The software and documentation can be free downloaded from http://nft.nefsc.noaa.gov/

11 ToR K Future planning of Mediterranean expert group meetings

The EWG 11-05 noticed that it received an informal invitation to hold the second meeting in the course of the year 2011 to estimate Mediterranean exploited stocks and fisheries, i.e. EWG 11-12, in Cyprus. The venue and logistics of that meeting will be confirmed and disseminated through the dedicated website of this meeting.

EWG 11-05 noticed that the third meeting in the course of the year 2011 to estimate Mediterranean exploited stocks and fisheries, i.e. EWG 11-20 originally planned to be held during the week 12-16 December 2011, has been moved by the STECF bureau to the week 16-20 January 2012. The EWG 11-05 noticed that it received an informal invitation to hold the meeting EWG 11-20 in Madrid.

12 ToR L Other Business

12.1 Influence of sea-bottom temperature on trawl swept-area estimations

The expert working group did not address this task due to lack of appropriate scientific expertise and working time.

12.2 Assessment of French management plans for the fishing fleets operating in the Mediterranean

12.2.1 Introduction

Two representatives (observers) from the French government did present the French management plans for fishing fleets operating in the Mediterranean during the meeting of STECF EWG 11-05. Relevant background documents were made available. In accordance with its ToR, STECF EWG 11-05 reviewed the content of the management plan and commented.

12.2.2 Major contents of the French management plan

The STECF EWG 11-05 noticed that the French management plan consists of two parts: the first one includes the overall objectives and implementation of the FMP regarding the regulation of the activity and gear characterization for trawl, boat seine (*senne de bateau*), purse- seining (*senne tournante coulissante)*, beach seine (*senne de plage*), *gangui* (small bottom trawl) and dredges; and the second one consists of the annexes, scientific data and reports (eight *dossiers thématiques*, listed at the end of this text) and GFCM reports (sixteen reports). The use of these five gears corresponds to different *métiers* within each gear (i.e. each of these fishing gears include different modalities that target different groups of species).

The STECF EWG 11-05 noticed that the French Management Plan contains the following major elements:

- The information about the current characteristics and regulation in force for the different activities related to each fishing gear is comprehensive.

- <u>Trawl</u>: The FMP includes bottom and pelagic trawl, with their specific characteristics and target species.

- <u>Purse seining and boat seine</u>: Purse seining refers to three métiers, targeting small pelagics and demersal species. Two métiers, the categories *senne allatchare* and *senne tournante*, are described as fishing on *Posidonia oceanica* beds. Boat seining is permitted over *Posidonia oceanic* beds provided that the gear does not touch the beds. A system of geo-location has been implemented for <15 m vessels.

- <u>Beach seine</u>: A system of geo-location has been implemented for <12 m vessels. Derogation in force for the traditional fishing *poutine,* a type of beach seine targeting larvae of sardine and other small pelagic species (*alevin de sardines et de différents petits poissons pélagiques non pigmentés*). This fishing is practised by three vessels.

- <u>Gangui</u>: Six métiers identified. Detailed information on the activity by métier and area is given. This fishing is practised within the 3 miles area over *Posidonia oceanica* beds, in line with the rules set out in article 4 of (EC) Regulations No 1967/2006. Mapping of the *Posidonia oceanica* beds has been provided, as required by regulation.

- <u>Dredges</u>: This gear is used within the 3 miles from the coast and in the lagoons, targeting five different groups of species. A Geo-location system for the <12 m vessels that use this gear is already implemented.

- For each fishing gear, information is provided on the métiers involved and the different steps foreseen in the FMP are mentioned, which are: i) the monitoring and scientific evaluation of these fisheries; ii) the other complementary measures mentioned in (EC) Regulations No 1967/2006 and No 2371/2002; and iii) intermediate evaluation of the FMP. If necessary, changes to the FMP are also considered to be made. Nevertheless, no explanation is provided as for how these measures will be implemented. We would like to draw attention to the following specific point: Article 6 (2), (3) and (4) of Council Regulation (EC) No 2371/2002 indicates that the management plans shall be multi-annual and should include an expected timescale to achieve the objectives of the plans. In line with this article's requirements, the objectives were stated for a time frame limited to two years. Planned actions after 2013 are not explained.

- Objectives of the different management plans are not well defined (the management plans are aimed at *encadrer de façon rationnelle et raisonnée l'activité*).

- Some of the measures foreseen in the plans are already put in place, as for instance, the fishing permits system.

- Monitoring of the different fishing gears and activities is proposed to be done through log-books in the case of trawl and by stratified sampling and questionnaires in the case of the different small-scale fleets considered in the FMP. This is necessary because the information by métier is not yet available. This monitoring is expected to show by the first semester of 2013 the compatibility with the Mediterranean Regulation. It is stressed that, should the fishing activities stop for which a derogation is required, the socio-economic consequences would be disproportionate in relation to the very small gain from the environment and fishing management perspective.

- A study about economic indicators and diagnosis is presented for the different small-scale fleets involved in the FMP. According to this study, in 2008, 214 fishing vessels were affected by at least one management plan, of which 105 were trawlers. Hake is considered to be the main target species of the bottom trawl fleet (22% of the landings of ≥18m trawlers). The thematic dossiers include a bio-economic study on the Gulf of Lions stock of hake exploited by three French fleets (bottom and pelagic trawl, gillnet) and two Spanish fleets (bottom trawl and longline).

- As for gangui, one report is presented on the selectivity of this gear and second one on the *Posidonia oceanica* beds all along the French Mediterranean coast. The *Posidonia oceanica* beds surface affected by the activity of gangui in the area of Toulon is estimated to be around 100 km^2.

- Given the large amount of information in the different documents and reports and time constraints, a response to the best of our knowledge is given to the specific questions addressed to STECF EWG 11-05. A more elaborated main document for all the plans would have been useful, highlighting the links among the documents and reports, since information required for one management plan can be found scattered among different documents. Not all the information provided in the different documents was relevant to the management plans. Furthermore, the FMP was available to EWGMED after the start of the meeting, in French.

Regarding the specific ToR to be addressed, STECF EWG 11-05 noticed that the French Management Plan addresses the following elements:

1. The biological characteristics and the state of the exploited resources

The stocks assessed in the frame of GFCM are anchovy, sardine, hake and red mullet. The stocks of hake and red mullet are overfished according to Fmsy or its approximation. The diagnosis of anchovy and sardine is based on the biomass estimations from acoustic surveys and no reference points are available for these species. No further information is available about the status of any other species targeted by the different fleets.

A table is presented in one of the annexes (excerpt from *Document préparatoire des Assises de la pêche 2009*) where it is indicated, based on MSY criteria, that sardine and anchovy are fully exploited (*pleinement exploités*), and hake and eel are over- exploited (*surexploités*). It is explained that in the near future more stocks will be assessed and that the low number of assessments is due to the lack of data by métier.

2. The fishing pressure and if concerned fisheries are duly described and expected to exploit main target stocks in line with their production potentials and if the plan is expected to maintain or to revert fisheries productivity to higher levels and in which time frame.

As explained above, the current status is unknown for most of the exploited stocks. Reference points are defined for hake and red mullet.

3. Impact of fishing activities on marine environment (protected habitats and species)

Based on MEDITS surveys, population indicators (trends of abundance and bathymetric distribution) are given for: *Lophius piscatorius, Lophius budegassa, Boops boops, Trisopterus minutus, Pagellus bogaraveo, Trachurus mediterraneus, Trachurus trachurus, Merluccius merluccius, Pagellus acarne, Pagellus erythrinus, Spicara smaris, Eledone cirrhosa, Eledone moschata, Octopus vulgaris, Mullus barbatus and Mullus surmuletus.* Such information, however, is of limited usefulness for the assessment of the current status of exploitation and sustainability of the fishing activities where these species are involved. The study concludes that the populations of the Gulf of Lions are stable with fluctuations.

A number of the studies annexed to the FMP deal with the impact of the fishing activities on the marine environment (mapping of *Posidonia oceanica* beds and marine protected areas; a geo-location system for <12 m vessels; the creation of a fisheries restricted area in the Gulf of Lions).

It is worth noting that other gears exploiting the hake spawners (e.g. Spanish longlines and French gill-netters) are not contemplated in the plan. The importance of crinoid beds (*Leptometra* spp) existing in the GSA07 (Gaertner *et al*. 1999) for the demersal resources of GSA07 is not documented, when in fact it has been shown in other Mediterranean areas that this constitutes a critical habitat for marine resources (Colloca *et al*. 2004).

It is explicitly acknowledged the lack of information on the impact on the environment of boat seiners, targeting small pelagic and demersal species, and beach seiners (document *PGM_Ifremer_Dossier_Activites*).

Little is still known about the impact of gangui, utilised by small-scale fishers in shallow waters, on *Posidonia oceanica* meadows. However, the report acknowledges there is an impact of gangui on juveniles of several coastal species inhabiting these meadows. Some individuals are undersized (e.g. *Mullus surmuletus* measuring less than 11.5 cm). For other species captured with gangui having a minimum landing size (e.g. *Diplodus* spp, *Pagellus erythrinus*, etc) the size distribution is not given in the report and therefore it is not possible to evaluate if they are undersized or not.

In the IFREMER study case on gangui, it was concluded that the use of the regulated gangui (40 mm square mesh) instead of the traditional gear (22 mm diamond size) would reduce by 29% the catch juveniles and the economic value of landings would decrease by 58%, which might result into an increase of fishing effort due to the expected shrinkage of the fisherman income.

As for dredges, little is still known about their impact, utilised by small-scale fishers in coastal waters to catch bivalvs and gastropods, particularly if we consider that the annual proportion of vessels that exclusively carry out this activity is increasing (see page 74 of the document *Indicateurs et diagnostics des activités de pêche concernées: chalutage, sennes tournantes, dragues, gangues et sennes de plage*).

The FMP includes among the activities to be undertaken, the evaluation of the impact of the artisanal fishing activity on the environment. It is worth mentioning that several years passed by from the first request of information on the impact on the environment and sustainability of the gangui fishing activity. The fixed deadline was the 31/05/2009. Since this date up to now the MS did not collect the necessary information and now other two years are asked for fulfilling the request.

4. Size and/or species selectivity of the regulated fishing gears with particular attention to sizes and relative quantities of species mentioned in Annex III of the Mediterranean Regulation

This information is unknown for most of the métiers considered in the plan. A study on the *gangui* selectivity is presented.

12.2.3 Conclusions

STECF EWG 11-05 concludes that the complexity of the different type of fisheries in the area is particularly well described. Within each fishing gear, there are different modalities targeting different species in different habitats or depths. Nevertheless, the information on the conservation status and the biological characteristics of the stocks is rather limited, and the impact of small-scale fishing gears operating on coastal waters included in the management plan on habitats and species remains largely unknown and thus appears inadequately considered with regards to the precautionary principle. STECF EWG 11-05 concludes that the protection of the important coastal habitats, particularly the protected ones such as *Posidonia oceanic*a beds and coralligenous assemblages essential for the population dynamics of coastal species (nursery or spawning areas), appears poorly addressed.

STECF EWG 11-05 concludes that despite the large amount of information related to different aspects of the fishing activity, basic information which must be part of a management plan is missing. Major shortfalls identified in the FMP are the lack of knowledge of the status of most of the exploited stocks, a clear definition of the objectives, and the justification of the time schedule proposed for the different management plans. The FMP indicates 01.01.2011 as starting date and a two years period for the preliminary phase of the plan. The objectives during this phase are defined as qualitative only.The French government announced a revision of the plan by the first semester in 2013, which shall include the required quantitative management objectives..

The FMP proposes to start the collection of specific fisheries information by métier, which to date is not available. To this aim, the plan identifies different traditional métiers, for which derogations are required to continue their activities, although it remains unclear to STECF EWG 11-05 whether such derogations have already been granted.

12.3 Considerations on the development of a framework for generating management advice in the Mediterranean fisheries

As a reflection about the ongoing discussions in GFCM regarding a framework for generating management advice in the Mediterranean fisheries EWG 11-05 discussed and reviewed relevant political agreements, the responses of other European advisory bodies (mainly ICES) and its own conclusions.

The ecosystem approach, precautionary approach and Maximum sustainable yield (MSY) framework are the major themes of the agreements and policies that set the context for EU-STECF advice. Maximum sustainable yield is a broad conceptual objective intended at achieving the highest yield possible over the long term (i.e. an infinitely long period of time). Within the MSY concept, EU has recently agreed to “Maintain or restore stocks to levels that can produce the maximum sustainable yield with the aim of achieving these goals for depleted stocks on an urgent basis and where possible not later than 2015”. Ideally, a fishing mortality MSY reference level (i.e. F_{MSY}) should take into account recruitment, growth and natural mortality under current or recent ecosystem conditions and F_{MSY} should be derived through stochastic simulations of target F in the context of a harvest control rule. However, recruitment functions of most species are typically very noisy and poorly defined. Therefore, it is common to use proxies for F_{MSY}, such as F_{max}, $F_{0.1}$, $F_{20\text{-}40\%SPR}$ and many others. Thus F_{MSY} is used as a generic term for a robust estimate of a fishing mortality level that is associated with high yield in the long term. When information for determining reference points for a fishery is poor or absent, provisional reference points shall be anyhow set.

The precautionary approach is described in the UN Fish Stocks Agreement (UN, 1995) as follows: “States shall be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.”

The ecosystem approach, precautionary approach and MSY are embedded within several international agreements, policies and/or legal instruments. Those are listed below as taken from the ACOM document (“General context of ICES advice”) published the 20th of May 2011 by ICES:

- United Nations Convention on the Law of the Sea (UN, 1982 (known as UNCLOS)) which includes a call for a maximum sustainable yield (MSY) approach for managing fisheries;
- United Nations Conference on Environment and Development (UN, 1992a (known as UNCED)) including Chapter 17 of Agenda 21 which highlights the precautionary approach;
- United Nations Straddling Fish Stocks agreement of 1995 (UN, 1995 (known as the UN Fish Stocks Agreement or UNFSA)) and the FAO Code of Conduct for Responsible Fisheries (FAO, 1995) which call for a precautionary approach;
- Convention on Biological Diversity (UN, 1992b (known as CBD)) which calls for conservation of biological diversity through an ecosystem approach;
- Johannesburg Declaration of the World Summit of Sustainable Development (UN, 2002 (known as WSSD)) which calls for an Ecosystem Approach and rebuilding fisheries to maximum sustainable yield

- The Common Fisheries Policy of the European Union (EC, 2002)
- Communication from the European Commission on Implementing Sustainable Fisheries in EU Fisheries Through Maximum Sustainable Yield (EC, 2006)
- The Marine Strategy Framework Directive (EC, 2008)

Generally, any fishery management strategies shall ensure that the risk of exceeding reference points is very low and it should initiate actions to facilitate stock recovery for stocks that are currently below reference points.

EWG 11-05 noticed the advisory frameworks are weak in particular regarding stocks without indicator of exploitation level and/or stock status. For many fish stocks, the data available are inadequate to estimate the current population size and the catch resulting from fishing at a given target F. The MSY approach calls for a determination of the status of exploitation relative to F_{MSY} and considerations of the stock trend.

The following table is currently used by ICES ("General context of ICES advice") to give advice for stocks without population size estimates.

	No Overfishing	**Overfishing or Unknown Exploitation Status**
Decreasing stock trend	Reduce catch at rate of stock decrease	Reduce catch at rate greater than the rate of stock decrease
Stable stock trend or no trend information	Do not allow catches to increase	Reduce catch.
Increasing stock trend	Increase catch at rate of stock increase	Do not allow catches to increase

EWG 11-05 concludes that this approach appears appropriate to generate management advice on Mediterranean fisheries. In relation to the report of GFCM 2011 (GFCM:XXXV/2011/Inf.5) and the traffic light approach defined in table 3 of the same document, STECF (STECF November Plenary session 2010) has recently stated that a simple management of fisheries targeting stocks of small pelagics in the Mediterranean that is based solely on effort reductions implies a high risk of stock collapse due to their schooling behavior and the multi-species character of their fisheries (i.e. switching target species as available and appropriate). Thus, EWG 11-05 reiterates previous STECF recommendations which suggest landing restrictions (i.e. TAC) represent a more effective management tool for small pelagics in the Mediterranean Sea. Such landing limitations would also contribute to solve potential multi-species conflicts in the relevant fisheries for small pelagic.

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15 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on: https://stecf.jrc.ec.europa.eu/meetings

List of background documents:

1. EWG-11-05 – Doc 1 - Declarations of invited and JRC experts.
2. EWG-11-05 – Doc 2 - Indicateurs et diagnostics sur les espèces exploitées par les activités de pêche: chalutage, sennes tournantes, dragues, ganguis et sennes de plage (73 pages). Extraits du rapport d'Avril 2010 produit en réponse à la saisine 09-2829 de la DPMA concernant le plan de gestion Méditerranée, conformément aux dispositions de l'article 19 du règlement (CE) n°1967/2006
3. EWG-11-05 – Doc 3 - Indicateurs et diagnostics sur les espèces exploitées par les activités de pêche : chalutage, sennes tournantes, dragues, ganguis et sennes de plage (114 pages). Extrait du rapport d'Avril 2010 en réponse à la saisine 09-2829 de la DPMA concernant le plan de gestion Méditerranée, conformément aux dispositions de l'article 19 du règlement (CE) n° 1967/2006
4. EWG-11-05 – Doc 4 - Note sur la création par la CGPM d'une Zone de pêche réglementée dans le golfe du Lion en mars 2009 (Avril 2011 - R.INT.RBE/HMT 2011-002; 20 pages)
5. EWG-11-05 – Doc 5 - Choix et mise en œuvre d'une solution de géolocalisation des navires de pêche de moins de 12 mètres (Avril 2011 - R.INT.RBE/HMT 2011-001; 37 pages)
6. EWG-11-05 – Doc 6 - La sélectivité du gangui à panneaux des cotes varoises : Analyse comparative de l'application de la maille carrée de 40 mm (HMT/RH-Sète 2010 – 002; 32 pages)
7. EWG-11-05 – Doc 7 - Indicateurs et diagnostics économiques des flottilles concernées par le plan de gestion (31 pages)
8. EWG-11-05 – Doc 8 - Indicateurs et diagnostics économiques des flottilles concernées par le plan de gestion (31 pages)
9. EWG-11-05 – Doc 9 - Groupe de travail partenarial pour la construction d'outils bio-économiques d'aide à la décision pour l'aménagement des pêcheries : Extraits du Rapport final (34 pages)
10. EWG-11-05 – Doc 10 - Cartographie des herbiers de posidonies et des aires marines protégées (33 pages)
11. Lloret, J and M. Muñoz 2011 mimeographed, Doc.11, University of Girona: A Case Study Showing the Data Shortcomings to Assess Mediterranean Coastal Species, 8 pp.

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Abstract

The EWG 11-05 met in Ponza Island (Italy), 23-27 May 2011 to carry on STECF's mandate for assessing Mediterranean stocks and provide fisheries management. The meeting was chaired by A. Abella and attended by seventeen experts, including four STECF members and two JRC experts.

The major ToRs (A-E), the assessment of Mediterranean exploited stocks and fisheries, were addressed by revising assessment results provided by the expert group in 2010 and defining the status of stocks which have not been assessed before. The assessments of recent and historic stock parameters and fisheries as well as management advice provided in the present report is constrained for the Geographical Sub-areas (GSA) off Spain, Italy and Malta since no experts from Cyprus, France, Greece and Slovenia attended the meeting.
The EWG 11-05 devoted some time to verify the data obtained during the DCF Mediterranean data call in 2010 (ToR F) for completeness and accuracy. The present report contains findings for further consideration by STECF and DG Mare regarding GSAs off Spain, Italy and Malta as well as comments regarding small pelagic and spatial coverage of costal species. ToRs G covered the task of the development of appropriate biological indicators, and methods for stock assessments in poor data situation were addressed. The EWG 11-05 started to discuss and evaluate the mixed fisheries frameworks and computer programs to deliver mixed fisheries management advice under various scenarios (ToR I). As many of the Mediterranean fisheries are classified as mixed fisheries, this specific issue is considered very important and relevant analyses shall be continued during the forth-coming meetings.STECF EWG 11-05 initiated its evaluation of the French management plan as presented at short notice.

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